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Pelagic Fisheries of the Western Pacific Region

1998 Annual Report

November 1998

Western Pacific Regional Fishery Management Council
Honolulu, Hawaii

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Pelagic Fisheries of the Western Pacific Region

1998 Annual Report

Draft 12/01/99

December 1999

Prepared by the Pelagics Plan Team and Council Staff

for the

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400, Honolulu, Hawaii 96813

A report of the Western Pacific Regional Fishery Management Council pursuant to
National Oceanic and Atmospheric Administration Award No. NA77FC0008

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Pelagic Fisheries of the Western Pacific Region — 1998 Annual Report

I. Introduction

A. Background

The Fishery Management Plan (FMP) for Pelagic Fisheries of the Western Pacific Region was implemented by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) on 23 March 1987. The Western Pacific Regional Fishery Management Council (WPRFMC, or Council) developed the FMP to manage the pelagic resources that are covered by the Magnuson Fishery Conservation and Management Act of 1976 and that occur in the US Exclusive Economic Zone (EEZ) around American Samoa, Guam, Hawaii, the Northern Mariana Islands, and the US possessions in the Western Pacific Region (Johnston Atoll, Kingman Reef and Palmyra, Jarvis, Howland, Baker, Midway, and Wake Islands).

The objectives of the Pelagics FMP were revised in 1991. The abridged objectives are to:

- Manage fisheries for Pacific pelagic management unit species (PPMUS) to achieve optimum yield (OY).
- Promote domestic harvest of and domestic fishery values associated with PPMUS[1] (e.g., by enhancing the opportunities for satisfying recreational fishing experience, continuation of traditional fishing practices and domestic commercial fishers to engage in profitable operations).
- Diminish gear conflicts in the EEZ, particularly in areas of concentrated domestic fishing.
- Improve the statistical base for conducting better stock assessments and fishery evaluations.
- Promote the formation of regional/international arrangements for assessing and conserving PPMUS throughout their range.
- Preclude waste of PPMUS associated with longline, purse seine, pole-and-line or other fishing operations.
- To promote domestic marketing of PPMUS in American Samoa, Guam, Hawaii and the Northern Mariana Islands.

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[1] The Magnuson Act was amended to allow the inclusion of tunas in US fishery management authority as of January 1992. In the Pacific, tuna management is the responsibility of the regional fishery management councils. Pacific pelagic management unit species (PPMUS) includes former pelagic management unit species (PMUS) and tunas.

Non-tuna PPMUS are sometimes referred to as "other PPMUS" in this report. This term is equivalent to PMUS (Pelagic Management Unit Species) used in annual reports previous to 1992, before tunas were included in the management unit.

The PPMUS are caught in the troll, longline, handline and pole-and-line (baitboat) fisheries. They are caught in oceanic as well as insular pelagic waters. Most of these species are considered to be epipelagic because they occupy the uppermost layers of the pelagic zone. All are high-level predators in the trophic sense. Pelagic fisheries for PPMUS are among the most important, if not the dominant Pacific Island fisheries.

B. Report Content

This report contains fishery performance data from each of the four island groups through 1998, interpretations of trends or important events occurring in the fisheries and recommendations. This report was prepared using reports submitted by the following agencies . The Hawaii report is an integration of State of Hawaii Division of Aquatic Resources and NMFS summaries.

- Territory of American Samoa, Department of Marine and Wildlife Resources
- Territory of Guam, Division of Aquatic and Wildlife Resources
- Territory of Guam, Department of Commerce
- State of Hawaii, Division of Aquatic Resources
- Commonwealth of the Northern Mariana Islands, Division of Fish and Wildlife
- NMFS, Southwest Region (including Southwest Fisheries Science Center Honolulu Laboratory, Pacific Islands Area Office and Office of Law Enforcement)
- US Coast Guard, District 14
- Pelagic Fisheries Research Program, University of Hawaii

C. Report Appraisal

The report content has not changed significantly from previous years.

D. Plan Team Members

The FMP requires the Council's Pelagic Plan Team (Team) to prepare an annual report on the status of the pelagic fisheries taking place in each of the island areas served by the Council (American Samoa, Guam, Hawaii and Northern Mariana Islands), to evaluate the effectiveness of the FMP in meeting its goals and objectives, and make recommendations for future management and administrative action.

1998 Pelagic Plan Team Members

American Samoa
Fini Aitaoto
Dept. of Marine & Wildlife Resources
PO Box 3730
Pago Pago, AS 96799
Tel: (684) 633-7293
Fax: (684) 633-5944

Guam
Tom Flores
Div. of Aquatic and Wildlife Resources
192 Dairy Road
Mangilao, GU 96923
Tel: (671) 735-3958
Fax: (671) 734-6570

Hawaii
Christofer H. Boggs (Chair)
Russell Y. Ito
Pierre Kleiber
Dave Hamm
Samuel Pooley
Robert A. Skillman
Honolulu Laboratory
National Marine Fisheries Service
2570 Dole Street
Honolulu, HI 96822-2396
Tel: (808) 948-9706
Fax: (808) 943-1290

Walter N. Ikehara
Hawaii Division of Aquatic Resources
1151 Punchbowl Street, #330
Honolulu, HI 96813
Tel: (808) 587-0096
Fax: (808) 587-0115

John Sibert
SOEST/JIMAR
1000 Pope Road, MSB 312
Honolulu, HI 96822
Tel: (808) 956-4109
Fax: (808) 956-4104

Northern Mariana Islands
Floyd R. Masga
Division of Fish and Wildlife
Department of Land & Natural Resources
P.O. Box 10007
Saipan, MP 96950
Tel: (670) 322-9627
Fax: (670) 322-9629

Secretariat of the Pacific Community
Keith Bigelow
Oceanic Fisheries Programme
P.O. Box D5
Noumea Cedex 98858
New Caledonia
Tel: 011 (687) 26-0192
Fax: 011 (687) 26-3818

Council Staff
Paul Dalzell
Western Pacific Regional Fishery
Management Council
1164 Bishop St, #1400
Honolulu, HI 96813
Tel: (808) 522-8220
Fax: (670) 522-8226

Table 1. Names of Pacific pelagic management unit species

English Common Name	Scientific Name	Samoan or AS local	Hawaiian or HI local	Chamorroan or Guam local	S. Carolinian or NMI local	N. Carolinian or NMI local
Mahimahi (dolphinfishes)	*Coryphaena* spp.	Masimasi	Mahimahi	Botague	Sopor	Habwur
Wahoo	*Acanthocybium solandri*	Paala	Ono	Toson	Ngaal	Ngaal
Indo-Pacific blue marlin Black marlin	*Makaira mazara:* *M. indica*	Sa'ula	A'u, Kajiki	Batto'	Taghalaar	Taghalaar
Striped marlin	*Tetrapturus audax*		Nairagi			
Shortbill spearfish	*T. angustirostris*	Sa'ula	Hebi	Spearfish		
Swordfish	*Xiphias gladius*	Sa'ula malie	A'u kū, Broadbill, Shutome	Swordfish	Taghalaar	Taghalaar
Sailfish	*Istiophorus platypterus*	Sa'ula	A'u lepe	Guihan layak	Taghalaar	Taghalaar
Oceanic sharks	Alopiidae, Carcharinidae, Lamnidae, Sphynidae	Malie	Mano	Halu'u	Paaw	Paaw
Albacore	*Thunnus alalunga*	Apakoa	'Ahi palaha, Tombo	Albacore	Angaraap	Hangaraap
Bigeye tuna	*T. obesus*	Asiasi, To'uo	'Ahi po'onui, Mabachi	Bigeye tuna	Toghu, Sangir	Toghu, Sangir
Yellowfin tuna	*T. albacares*	Asiasi, To'uo	'Ahi shibi	'Ahi, Shibi	Yellowfin tuna	Toghu
Northern bluefin tuna	*T. thynnus*		Maguro			
Skipjack tuna	*Katsuwonus pelamis*	Atu, Faolua, Ga'oga	Aku	Bunita	Angaraap	Hangaraap
Kawakawa	*Euthynnus affinis*	Atualo, Kavalau	Kawakawa	Kawakawa	Asilay	Hailuway
Dogtooth tuna	*Gymnosarda unicolor*	Tagi	Hagatsuo	Dogtooth or white tuna	Ayul	Owel
Moonfish	*Lampris* spp	Koko	Opah		Ligehrigher	Ligehrigher
Oilfish family	Gempylidae	Palu talatala	Walu, Escolar		Tekiniipek	Tekiniipek
Pomfret	family Bramidae	Manifi moana	Monchong			
Other tuna relatives	*Auxis* spp, *Scomber* spp; *Allothunus* spp	(various)	Ke'o ke'o, saba (various)	(various)	(various)	(various)

Table 2. Total 1998 pelagic landings[2] (in lbs) in the Western Pacific Region

Species	American Samoa	percent change	Guam	percent change	Hawaii	percent change	Northern Marianas	percent change	Total	percent change
Barracuda	4,474	-51.1%	6,819	143.4%			99	-44.1%	11,392	-6.1%
Kawakawa	82	-77.8%	3,576	9.8%					3,658	0.9%
Mahimahi	30,961	-17.0%	251,357	-1.0%	800,000	-27.3%	20,529	-18.0%	1,102,847	-22.1%
Marlin, Black	0	-100.0%							0	-100.0%
Marlin, Blue	42,097	10.9%	43,616	-52.1%	1,300,000	-31.6%	3,361	-40.6%	1,389,074	-31.7%
Marlin, Striped					900,000	0.0%			900,000	0.0%
Misc. Billfish					400,000	0.0%			400,000	0.0%
Misc. Pelagics			15,199	-8.7%	300,000	50.0%	740	-62.3%	315,939	44.5%
Moonfish	1,749	-38.6%			900,000	12.5%			901,749	12.3%
Pomfret										
Rainbow Runner	512	-1.7%	1,928	-57.9%			603	-18.5%	3,043	-47.9%
Sailfish	6,701	8.6%	700	1000%			83	-17.0%	7,484	19.3%
Sharks	7,404	-34.1%	8,017	53.1%	6,300,000	26.0%			6,315,421	25.9%
Spearfish			894	1000%					894	1000%
Swordfish	3,373	737.0%			7,200,000	12.5%			7,203,373	12.5%
Tuna, Albacore	637,821	1.6%			3,000,000	-25.0%			3,637,821	-21.4%
Tuna, Bigeye	5,695	2.7%			7,400,000	32.1%			7,405,695	32.1%
Tuna, Bluefin					40,000	-20.0%			40,000	-20.0%
Tuna, Dogtooth	668	70.0%	356	-80.8%			14,426	89.4%	15,450	56.6%
Tuna, Misc.	366	-5.7%					2,213	-42.1%	2,579	-38.7%
Tuna, Skipjack	54,073	58.1%	191,054	-9.4%	1,200,000	-53.8%	133,819	25.3%	1,578,946	-46.5%
Tuna, Yellowfin	75,052	1.7%	138,351	52.4%	3,400,000	-26.1%	11,656	-31.9%	3,625,059	-24.2%
Wahoo	36,252	141.7%	155,690	139.4%	700,000	-12.5%	5,039	-16.9%	896,981	1.2%
TOTAL	907,425	17.6%	817,087	9.6%	33,840,000	-1.5%	192,568	10.0%	35,757,405	-1.0%

* NMFS Hawaii longline logbook summaries aggregate several billfish and tuna species (noted with *) into miscellaneous billfish, tuna, and pelagics categories. All Hawaii totals shown here are NMFS estimates and rounded to the nearest 100,000 lb, except for bluefin tuna and misc. tunas.

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2 Landings are reported in island reports (Appendices 1-4), which include recreational and commercial domestic landings data, where available (e.g., for Hawaii, only commercial landings). In some cases, totals may not add precisely due to rounding. These do not include foreign transshipment or domestic cannery landings, which may be reported separately in island modules.

II. Summary [3]

A. Plan Administration

No FMP or regulatory amendments governing pelagic fisheries in the Western Pacific Region were proposed by the Council in 1998. See Administrative Activities (p. 14) for details. No permits were requested by any foreign nations to fish in the US EEZ of the Western Pacific Region.

B. Island Areas

In **American Samoa,** fishing effort and landings of PPMUS continued the upward trend that commenced in 1994. This continuation reflects the interest in small scale longline fishing in the territory, targeting mainly albacore. An estimated 909,425 lb (+ 17.6%) of pelagic fish were landed in 1998, of which 820,783 were commercial landings valued at $ 998,930 (+3%). The average price for all pelagics was $1.22/lb (+10%).

The number of boats in the pelagic fishery during 1998 decreased 13% from 1997. A total of 47 vessels made an estimated 2,482 trips (-9%), comprising 123 trolling trips (-84%) and 2,359 longline trips (+17%). The average duration of all fishing trips was 7.8 hr/trip, a 15% increase from the 6.8 hr/trip in 1997. Longline trips were on average two and a half hours longer than trolling trips (7.9hrs vs 5.2 hrs). This trip duration increase represents a continued shift from troll to longline fishing method. In contrast to 1996 when twice as many fishing trips used trolling gear and 1997 when longline to troll trips was 3:1, the ratio of longline to troll trips in 1998 was over 19:1 (2,359 longline trips vs 123 trolling trips). Data from the troll fishery suggests that the catch per unit effort (CPUE) in 1998 was its lowest since 1982, but only 17% less than the previous five year average. The overall average CPUE for longline fishing in 1998 was 32 fish/1,000 hooks, of which 20.3 fish/1,000 hooks, or 63%, were albacore. Overall longline catch rates (-19%) as well as albacore catch rates (-35%) dropped between 1997 and 1998.

Cannery landings at Pago Pago during 1997 comprised 112,764 t of skipjack, 41,000 t of yellowfin and 54,500 t of albacore. Most of the skipjack and yellowfin are caught in distant water fisheries, predominantly in the western tropical Pacific, while albacore landings are made by vessels operating in cooler waters to the south of American Samoa. Landings have remained relatively stable during the 1990s for skipjack, while a substantial increase in yellowfin (+30%) and albacore (doubled since 1993) has occurred. This partially reflects the increased longline fishing activity in both American Samoa and Samoa (formerly Western Samoa).

In **Guam** landings of all pelagics amounted to 817,087 lb (9.6%), with total revenues increased to $711,066 (+37%). Non-Tuna PPMUS landings increased similarly to 460,722 lb (10.3%), and adjusted revenues increased to $503,600 (+43%). Tuna landings increased to 375,782 lb

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[3] Percentages in parentheses indicate percent change from previous year

(+23%), with a matching increase revenues (+27%) to $197,677. The overall landings have fluctuated around a relatively constant average for the past decade. Landings in 1998 followed the 1997 trend in Guam's pelagic fisheries towards targeting other PPMUS, principally mahimahi and wahoo, rather than tuna. Tunas comprised about 41% of the 1998 pelagic landings, similar to 1997 where they formed 40% of pelagic landings. Mahimahi comprised 31% of the total pelagic landings, followed by skipjack (23%), wahoo (19%, up from 9% in 1997), yellowfin tuna (17%) and blue marlin (5%).

Guam's adjusted prices for pelagic fish remained fairly stable in 1998, following a general decline since 1980. The adjusted price ($/lb) of tuna has remained static since 1996, and non-tuna PPMUS has continued to increase since 1995 and rose by 5% between 1997 and 1998.

Virtually all the landings of pelagic fish are made by trolling vessels. The fleet size in 1998 was 438 vessels (-6%). The decline in the fleet reflects a two year trend from a previously marked increase that began in 1980. Nevertheless, the number of trips (14,324), hours fished (59,583) and hours per trip (4.2%) remained unchanged from the 1997 data.

Transhipment activity in Guam markedly increased in 1998, possibly because of the reversal of 1997 climate changes (the strong El-Nino Southern Oscillation event) that negatively affected migrating pelagic fish stocks to the region.

The **Hawaii** fisheries for PPMUS produced total pelagic landings of 33.8 million lb in 1998, a slight decrease (-1.5%) from 1997. Swordfish landings of 7.2 million lb in 1998 were 12.5% higher than in 1997. Bigeye tuna surpassed swordfish as the dominant species comprising 21.9% and 21.3% of the pelagic fishery, respectively. Other major components of the pelagic fishery include sharks (18.6%), yellowfin (10%) and albacore (9%), other tunas (8%). Blue marlin catches declined dramatically (-32%) from 1997 while striped marlin remained unchanged. Mahimahi, wahoo and moonfish landings have fluctuated around a steady average for the past six years. Tuna landings dropped slightly in 1998 from a large increase in 1997. The numbers of sharks retained for their fins increased again in 1998, with an estimated landed whole weight increase of 34%.

Total pelagics revenue decreased by about 10% to $ 54.7 million, with an average price per pound decrease of 10% for pelagic fish in 1998. In 1998 the inflation adjusted ex-vessel revenue for the longline fishery decreased 9%, the handline fishery decreased by 30%, the troll fishery decreased 20% and the 1998 aku baitboats decreased by 63%.

Changes in catch rate by trollers were down for all species from 1997; blue marlin (-31%), skipjack (-14%), yellowfin (-11%), mahimahi (-4%) and ono (-0%). Rates for handliners varied by species in 1998; swordfish(+12%), wahoo (+4.5%), blue marlin (-59%), mahimahi (0%), yellowfin (+12%), albacore (+17%), bigeye tuna (71%). Yellowfin was the only species below its long term average.

The Hawaii longline fleet landed 28.6 million lb of fish, a 5% increase on the 1997 landings. Of the billfish landed in Hawaii, longlining accounted for almost all the swordfish (99.8%), striped

marlin (95%) and blue marlin (66%). About 34% of the longline landings (9.8 million lb) were billfish, and 73% of billfish landings were swordfish. The longline fleet also accounted for most of the bluefin tuna (90%), bigeye tuna (96%), albacore (82%), moonfish (100%) and sharks (100%) landed in Hawaii. The bluefin landings decreased (-31%) from 1997.

Fishing effort for the combined pelagic fisheries in Hawaii remained at a high level in 1998. The number of longline vessels participating in this fishery increased slightly from 105 vessels making 1,125 trips in 1997 to 114 vessels making 1,140 trips in 1998. The size of the longline fleet declined steadily between 1991 and 1996 from 141 to 103 vessels, although there are a maximum of 164 licenses available in the limited entry system. The number of trips by the troll fishery decreased in 1998 (-11%) to 21,112. This is higher than the 1979-1998 average of 18,274, but the fishery has been relatively static over the past ten years. The number of trips taken by aku baitboats (223) declined substantially (-50%). The present level of aku boat activity, in terms of trips, is about one third the long term average. The number of handline trips in 1998 (5,091) was a 16% decrease on fishing activity compared with 1997.

Landings of all pelagics in the **Northern Mariana Islands** (NMI) increased (+10%) between 1997 and 1998 to 192,568 lb but was only 1% above its long term average. The increase is most likely due to the below average fishing season in 1997 from particularly bad weather (typhoons and super typhoons) causing severe damage on some islands and keeping fishers off the water. Skipjack landings of 133,819 lb were up (+25%) from 1997, only slightly lower (-2%) than the 1983-1997 long term average. Yellowfin tuna landings were markedly reduced (-32%) for the second consecutive year and slightly below the long term average. Landings of mahimahi were down (-20 %) from 1997 but were still significantly higher than the long term average. Wahoo landings declined by (-17%) and were equally below the long term average. Blue marlin landings also declined markedly (-41%), but were still slightly above the long term average.

The 10% increase in landings during 1998 were reflected by a 5% increase in total adjusted revenues ($398,086) over those in 1997. This 5% increase in adjusted revenues was shared equally between tunas and other PPMUS.

The number of fishers making commercial pelagic landings declined for the second straight year (-17%) in 1998 to 89, but remained above the long term average. The number of trips landing PPMUS increased (+9%) in 1998 and was much higher (+34%) than the long term average.

The inflation adjusted prices of non-tuna PPMUS increased by 8% while tunas decreased by 8% in 1998, but both have remained fairly stable since 1993. The average adjusted price of tunas fell to $2.02/lb and of other PPMUS to $2.23/lb, both 6% above the long term average.

C. Species

Mahimahi landings (30,961 lb) in American Samoa during 1998 decreased slightly (-17%) from 1997, which had significantly higher landings than any time in the past. Guam's 1998 mahimahi landings (251,357 lb) were almost the same as 1997 (-1%) and considerably higher than the long-term average. Mahimahi landings in Guam have displayed wide, unexplained annual

fluctuations since 1987. The trolling catch rate for mahimahi has, however, remained relatively stable over the past three years. Mahimahi landings (800,000 lb) made up 4.3% of the 1998 non-tuna PPMUS landings in Hawaii, a decrease of 32%. The longline fishery accounted for 41% of the 1998 landings, with the bulk of mahimahi landings coming from the combined troll and handline fisheries. The troll catch rate in Hawaii was 4% lower than the 1998 rate, but above the long-term average. Northern Marianas mahimahi landings declined in common with most other species and amounted to 20,529 lb (-18%). Mahimahi accounted for 47% of the total non-tuna PPMUS landings. The trolling catch rate in 1998 in the NMI decreased from 1997 by 25% and was below the long-term average by 22%.

Blue marlin catches in American Samoa continued to increase (+11%) as a result of the expansion of the longline fishery, which took 98% of the total blue marlin catch. Guam landings of blue marlin (43,616 lb) were 52% lower than 1997 and 45% below its long-term average. Blue marlin landings (1.3 million lb) in Hawaii were 32% lower than in 1997 (1.9 million lb.) Longliners accounted for 65% of the total Hawaii blue marlin landings. Blue marlin landings in the Northern Marianas (3,361 lb) were significantly down from the previous year (-41%), in common with most species, but still slightly above the long-term average of 1983-1997.

The catch rate of blue marlin in the American Samoa troll fishery was markedly lower (-55%) than in 1997, and at its lowest rate since 1987. In Guam, blue marlin troll catch rate decreased markedly from 1997 (-50%), also 50% off the long-term average. In the Hawaii longline fishery, blue marlin tends to be caught incidentally at a higher rates on mixed trips than in either tuna trips or swordfish trips. The catch rate of blue marlin on tuna and swordfish trips decreased 25% between 1997 and 1998, while mixed trip catch rate decreased 50%. The catch rate of blue marlin in the Hawaii commercial troll fishery decreased (-45%) and was 33% lower than the long-term average. In the Northern Marianas, the 1997 catch rate was lower than in 1998 (-45%) and 25% below the long-term average.

Striped marlin landings ranked third among the billfish in Hawaii (after swordfish and blue marlin), and in 1998 it accounted for 5% of the commercial landings of non-tuna PPMUS. The 1998 landings of 0.9 million lb were the same as the 1997 landings and lower than the long-term average. Striped marlin is regarded as a secondary target species (after bigeye tuna) in the winter longline fishery and was the third in terms of volume of total longline landings of billfish after swordfish and blue marlin. Landings in the Hawaii commercial troll and handline fisheries during 1998 (43,000 lb, -48%) were markedly reduced from the previous year and about 51% below the long-term average. The species rarely appears in the domestic landings from other areas.

Sailfish landings were insignificant in most areas. American Samoa reported landings of 6,701 lb of sailfish in 1999, a 9% increase on 1997 landings and four times greater than the long-term average.

Estimated domestic landings of Hawaii **shark** increased by 26% between 1997 and 1998. The increase was due to a rise in the retention of shark fins, of which 95% are from blue sharks. Shark landings from other areas were relatively minor. Virtually the entire shark landings come

from longline vessels. However, the Bottomfish Plan Team has also noted that Northwestern Hawaiian Islands bottom fishery also lands fins of coastal and reef sharks taken incidentally [4], although the quantity has not been estimated.

Shortbill spearfish landings were only reported for Guam at 894 lbs.

The **swordfish** longline fishery in Hawaii began in 1989 with landings of 0.6 million lb, increasing to 3.4 million lb in 1990, and peaking at 13.1 million lb in 1993. Swordfish landings declined in 1994 and 1995 but may be leveling out and stabilizing at about 6-7 million lb. Landings in 1998 amounted to 7.2 million lb, a large increase from the long term average for the fishery. The estimated average size of longline-caught swordfish was 176 lb in 1998, above the 1987-1998 average by 13%. Swordfish comprised the largest proportion of the total non-tuna landings by all fisheries in Hawaii for the ninth consecutive year (38% in 1998, 37% in 1997, 38% in 1996, 38% in 1995, 60% in 1994, 72% in 1993, 73% in 1992, 62% in 1991, and 38% in 1990). The longline catch rate of swordfish in 1998 dropped by 6% from its seven-year high in 1997. 1998 CPUE was still 5% higher than the long-term average between 1991 and 1997. Swordfish landings from non-longline gear were negligible in comparison (0.2%). Other areas did not report landings of swordfish, apart from a few captures in the American Samoa longline fishery.

American Samoa reported landings of 637,821 lb of **albacore** during 1998, the highest yet recorded by the American Samoa fleet and a threefold increase on 1996 landings. Hawaii total landings of albacore (3.0 million lb) was a 25% drop from 1997, but 40% above its long term average. Landings of albacore by longline vessels decreased by 32% in 1998. Other areas did not report landings of albacore.

Hawaii landings of **bigeye tuna** (7.4 million lb) were 32% higher than 1997, almost all (96%) caught by longline. No other areas reported bigeye landings apart from American Samoa, where the emergent albacore fishery caught a modest 5,695 lb of bigeye tuna (+2.7%).

Skipjack tuna landings in American Samoa in 1998 (54,073 lb) rebounded from the 1997 52% drop, gaining 58%. The troll catch rate remained the same as 1997, which is 50% below the long-term average. Guam skipjack landings in 1998 (191,054 lb) represented a decrease of 9.4%, with catch rates 10% lower than in 1997. Hawaii skipjack landings (1.2 million lb) decreased dramatically (-54%) in 1998. The skipjack were caught principally by baitboats, which landed 696,000 lb of skipjack in 1998, one third the volume landed by the fishery in 1997. Northern Marianas Islands 1998 skipjack landings were 25% higher (133,819 lb) than 1997, and the catch rate increased by 15% from 1997 but was still far below the long-term average.

Yellowfin tuna landings in American Samoa (75,052 lb) increased by 1.7%; however, catch rates were 21% lower in the troll fishery than in 1997 and equally below the long-term average. Guam yellowfin landings (138,351 lb) increased 52% in 1998 and the catch rates were 44%

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[4]. WPRFMC Bottomfish Plan Team meeting, March 27-28 , 1996, Executive Centre Hotel, Honolulu, HI.

above 1997 and 35% above the long-term average. The total Hawaii commercial landings of yellowfin (3.4 million lb) were 26% lower than 1997 and equally below the long-term average. Landings of yellowfin by commercial trollers and handliners in 1998 were reduced by 29%, while landings by longliners increased by 79%. The commercial trolling catch rate of yellowfin decreased by 11% during 1998 and the catch rate from handline fishing increased by 12%. Longline catch rates of yellowfin by directed tuna trips were 20% below 1997 rates, but similar to the long-term average. Northern Mariana Islands yellowfin landings of 11,656 lb reflect a continued decline in 1998 (-32%), following a 43.7% drop in 1997. Catch rates were about 37% lower than in 1997, and 44% below the long-term average.

Wahoo landings in American Samoa increased to 36,252 lb (+142%), to the highest level yet. This increase in landings was generated mainly from the longline fishery as catch rates from trolling dropped by 38% to 0.62 lb/hr, but still higher than the long-term average (0.43 lb/hr). Guam's wahoo landings (155,690 lb) increased markedly by 140 % from 1997 with catch rates increasing by 135% from 1997. Wahoo landings in Hawaii decreased from 700,000 lb to 800,000 lb between 1997 and 1998. The 1997 trolling catch rate for wahoo in Hawaii remained stable from 1997, and was well above long-term average. Northern Marianas wahoo landings (5,039 lb) and catch rate (2.26 lb/trip) both decreased for the second straight year by 17% and 24% respectively. The catch was 26% below the long term average and the catch rate was half the long term average CPUE.

D. Gear

Troll fisheries continue to dominate the domestic fisheries in Guam and the Northern Mariana Islands, in contrast to American Samoa, where the emergent longline fishery now accounts for 97% of PPMUS landings. Growing charter fishing businesses in Guam and the Northern Mariana Islands contributed heavily to troll fishing effort. In Hawaii, longline landings continue to dominate pelagic fisheries production and in 1998 accounted for over 80% of the landed volume of PPMUS.

III. Issues

Bycatch and protected species interactions continued to drive most of the management initiatives of the Western Pacific Council in 1998. The Council's seabird-longline mitigation project was half completed by the end of 1998, resulting in a large volume of information on that measures may be the most suitable for the Hawaii-based longline fleet. This study was complemented in early 1999 by a mitigation study conducted by the NMFS Honolulu Laboratory from the NOAA research vessel *Townsend Cromwell*. Concern was also focused on blue shark catches as the Hawaii-based fleet continued to retain an increasing portion of the catch for finning. Calls for a ban on finning continued to be made in 1998 from non-government environmental and conservation groups. The Council and NMFS commenced a project to examine the socio-economic aspects of the shark fin trade in the Western Pacific Region. This study resulted in a report in 1999, which is the most thorough examination of shark finning in the Pacific and will be a standard reference for years to come (McCoy, M. & Ishihara, H. 1999). The socio-economic importance of sharks in the US Flag Areas of the Western and Central Pacific, Admin. Report

AR-SWR-99-01, National Marine Fisheries Service, Southwest Region, Honolulu, 119 pp). The longline fishery in American Samoa stabilized in 1998, with between 14 and 18 vessels active throughout the year, about the same as in 1997. A framework measure to implement a 50- and 30-nm area closure around the main islands and Swains Atoll, respectively, was sent to the SW Regional Administrator, but was subsequently disapproved. The Council in 1999 directed its staff to continue efforts of the closed area (see Administrative Activities, p. 14).

IV. Recommendations

i. **HDAR should continue to improve the collection of Hawaii fisheries data so that the data provide useful information on fishing effort.**

ii. **The Council should seek funding to conduct a survey of Hawaii small-scale fisheries. This survey is needed to evaluate the significance of non-commercial components of these fisheries.**

iii. **The Council should support an analysis of landings and catch rate trends of mahimahi and ono and other incidental catches (e.g. opah, pomfret, rainbow runner,) throughout the Western Pacific Region, including data from EEZ and distant-water fisheries.**

iv. **The Council should support an analysis of landings and catch rate trends of blue marlin throughout the Western Pacific Region, including data from EEZ and distant-water fisheries. NMFS Honolulu Lab will conduct a stock assessment of blue marlin.**

v. **Because the Hawaii-based longline fishery is expanding in terms of ports of landing, the Council should authorize NMFS to use VMS information to monitor logbook compliance. The pelagics plan team believes this information to be vitally important for other fishery monitoring and assessment purposes.**

vi. **The pelagics plan team asks that when the Council rejects or modifies a Plan Team recommendation, that this be noted in the annual report without modifying the original recommendation wording.**

V. Plan Administration

A. Administrative Activities

A regulatory amendment proposed by the Council to close an area around American Samoa to fishing for PPMUS by vessels more than 50 feet in length was disapproved by NMFS on March 11, 1999. NMFS determined that the proposal was not consistent with National Standard 4 (allocations of fishing privileges among US fishermen must be fair and equitable), National Standard 5 (restricting large vessels' access to the near-shore fishery would impose economic

costs, or inefficiencies, and the record for the proposal did not show those costs would have been outweighed by benefits to the stocks, fishing communities, or small vessel fishermen), and National Standard 7 (the closure would result in administrative and enforcement costs which did not appear justified in light of the projected benefits).

B. Longline Permits

During 1998, 164 permits, the maximum allowed under the FMP, were maintained in the Hawaii longline limited entry fishery. Administrative activities at PIAO primarily involved the transfer of 28 Hawaii longline limited permits. Of the 164 issued permit holders, 28 were without vessels for those permits. One receiving vessel permit was issued this year in Hawaii. PIAO also processed and issued Western Pacific general longline permits for the pelagic fisheries in American Samoa (49 permits), Guam (2 permits), and the Northern Mariana Islands (1 permit). The number of longline permits issued in American Samoa increased dramatically for the second straight year, with 16 new permits in 1998.

The names of vessels registered with Hawaii limited entry and Western Pacific longline permits and permit holders are listed in Table 3.

C. Foreign Fishing Permits

No administrative actions relating to foreign fishing in the western Pacific EEZ were required because no foreign fishing permits were requested for any vessels with which the US has a Governing International Fishing Agreement.

Table 3. 1998 Hawaii longline limited entry permit holders

Hawaii limited entry longline fishery

VESSEL	PERMIT HOLDER
F/V ADRAMYTTIUM	THK Fishing Inc.
F/V ANNA	MTA Corp.
F/V ARROW	David Kelly
F/V B-52	B-52 Inc.
F/V BARBARA H	Arthur/Barbara Haworth
F/V BIG AL	R & R Fisheries Inc.
F/V BLUE DRAGON	B Dragon Corp.
F/V BLUE FIN	Liet An Lu/Mai Thi Do
F/V BLUE SKY	Blue Sky Fishing Producer
F/V BRANDI	Success Inc.
F/V CANDACE	Natali Fishing Inc.
F/V CAPT. DAVIS	Ho Son Nguyen
F/V CAPT. DIAMOND	Capt. Diamond Inc.
F/V CAPT. GREG	Aquanut Co. Inc.
F/V CAPT. LE	L & T Fishery Corp.
F/V CAPT. MILLIONS I	Nga Van Le
F/V CAPT. MILLIONS III	Capt. Millions III, Inc.
F/V CAPT. MILLIONS IV	H and M Fishery Inc.
F/V CHRIS	Kan-Do Pesca Inc.
F/V CORI DAWN	Cori Dawn Corp.
F/V CRYSTAL	Davis B Inc.
F/V DAE IN HO	KYL Inc.
F/V DAE IN HO IV	Wynne Inc.
F/V DAEINHO III	Chunha Inc.
F/V DASHER II	DukSung Fishing Inc.
F/V DAWNING STAR	Larry B. & Dawn Powers
F/V DEBORAH ANN	Amko Fishing Co. Inc.
F/V DONGWON	Dongwon Marine Inc.
F/V DOUBLE D	Joseph Dettling
F/V EDWARD G	Edward G. Co. Inc.
F/V ELIZABETH VII	Tok Chun Son
F/V FINBACK	Finback Inc.
F/V FIREBIRD	Firebird Fishing Corp.
F/V GAIL ANN	Gail Ann Co. Inc.
F/V GARDEN SUN	Muoi Peter Ngo
F/V GLORY	Roy Yi
F/V GRACE	Sang Yeol Kim
F/V HAVANA	Thomas Webster
F/V HAWAII POWER	Intl. Quality Fishery Inc
F/V HEOLA	H & M Marine Inc.
F/V HOKUAO	White Inc.
F/V ICY POINT	Pacific Fisheries Corp.
F/V INDEPENDENCE	Independence Inc.
F/V JAGUAR T-L	Jaguar Inc.
F/V JANTHINA	Trans World Marine Inc.
F/V JENNIFER	Kil Cho Moon
F/V JOHN KENNEDY	Kinh Nguyen
F/V KAIMI	Vessel Management Assoc.
F/V KALOKE ANA	Kaloke Ana Fishing Inc.
F/V KASATKA	Artemon Basargin
F/V KATHERINE II	K.A. Fishing Co. Inc.
F/V KATHERINE III	K.R. Fishing Inc.
F/V KATHERINE Y	Song Fishing Corp.
F/V KATY MARY	Vessel Management Assoc.
F/V KAY	K.Y. Fishing Inc.
F/V KELLY ANN	Kelly Ann Corp.
F/V KEMA SUE	Kema Sue Inc.
F/V KILAUEA	Aukai Fishing Co.Ltd.
F/V KIM THANH I	Kim Thanh I Inc.
F/V KIMMY I	Kim Tran
F/V KING DIAMOND II	Scotty Nguyen
F/V KINGFISHER	Quan Do
F/V KINUE KAI	Awahnee Oceanics Inc.
F/V KOLEA	Paik Fishing Inc.
F/V KUKUS	Kuku Fishing Inc.
F/V LADY ALICE	Lady Alice Co. Inc.
F/V LADY ANN MARGARET	Lady Ann Margaret Inc.
F/V LADY CHRISTINE	Christine Tran
F/V LADY CHRISTINE II	Christine Tran Inc.
F/V LADY CHUL	Jong Ik Fishing Co. Inc.
F/V LADY LINDA	V Nam Inc.
F/V LEA LEA	M.S. Honolulu Inc.
F/V LIBERTY	Yu & AAS Corp.
F/V LIHAU	White Inc.
F/V LILA	Samuel Lee
F/V LUCKY I	Duoc Nguyen
F/V MAN SEOK	KMC & PCC Inc.
F/V MANA LOA	Two Bulls Inc.
F/V MARIE M	Viking V Inc.
F/V MARINE STAR	Viking V Inc.
F/V MIDNIGHT II	Albert K. Duarte
F/V MISS AGGIE N	Miles Gould
F/V MISS JESSICO	Pacific Seafoods Inc.
F/V MISS JULIE	Quan Do
F/V MISS LISA	Miss Lisa Inc.
F/V MOKULELE	Robert Cabos
F/V NORTHERN VENTURE	Roy-Al Boat Mgmt.
F/V OCEAN DIAMOND	Ocean Diamond Inc.
F/V PACIFIC DREAM	Pacific Seafoods Inc.
F/V PACIFIC FIN	Fishrite Inc.
F/V PACIFIC HORIZON	John Gibbs
F/V PACIFIC PRIDE	Pacific Seafoods Inc.
F/V PACIFIC REFLECTION	Gunn Pacific Reflection
F/V PACIFIC STAR	N. Pac Fishery Inc.
F/V PEARL HARBOR II	Gilbert DeCosta
F/V PETITE ONE	Ka'upu Ltd.
F/V PHI NAM	Pilgrim Truong
F/V PIKY	M/V Piky Inc.
F/V POHO NUI	Vessel Management Assoc.
F/V PRINCESS K	Princess K Fishing Corp.
F/V PURPLE MARCH	PN Inc.
F/V QUEEN DIAMOND	Santa Maria III Inc.
F/V RED BARON	Donald Aasted
F/V RED DIAMOND	Xuan Nguyen
F/V RED OCTOBER	Pacific Fishing & Supply
F/V ROBIN	Fat City Fishing
F/V ROBIN II	Robin Fishing Inc.
F/V SANDY DORY	Highliner Inc.
F/V SAPPHIRE	Hanh Thi Nguyen
F/V SEA BIRD	Seabird Inc.
F/V SEA DIAMOND	Nancy Nguyen
F/V SEA DIAMOND II	Sea Diamond II Inc.
F/V SEA DRAGON	Long Thanh Nguyen
F/V SEA GODDESS	Capt. Washington I Inc.
F/V SEA HAWK	Hawaii Fishing Co.
F/V SEA MOON	Sea Flower Inc.
F/V SEA QUEEN II	Thoai Van Nguyen
F/V SEA SPIDER	Paul Seaton, Trustee
F/V SEA SPRAY	Sea Spray LLC
F/V SEASPRAY	Hanson/Hanson Fishing Co.

F/V SEEKER II	Seeker Fisheries Inc.
F/V SEVEN STARS	Kwang Myong Co. Inc.
F/V SOUTH PACIFIC	South Pacific Fishing
F/V SPACER K	Hwa Deog Kim
F/V SUNFLOWER III	Le's Brothers Fishing Inc
F/V SWORDMAN I	Swordman Inc.
F/V TUCANA	Pacific Boat Corp. Inc.
F/V ULHEELANI	Ulheelani Corp.
F/V VAN LOI	Van Loi Corp.
F/V VICTORIA	Victoria Inc.
F/V VIRGINIA CREEPER	Sylvan Seafoods Inc.
F/V VOSTOK	Evgeny Basargin
F/V VUI VUI II	Vui Vui, A Limited Partne
F/V VUI-VUI	Santa Maria III Inc.
F/V WHITE NIGHT	Natalia/Kiril Basargin
F/V WONIYA	Sierra Fisheries Inc.

Hawaii longline permit holders without vessels

M&T Fishing Co. Inc.
James Chan Song Kim
Shaman Partnership
Vedoy Enterprises Inc.
Master Vincent Inc.
Hanh Thi Nguyen
Hanh Thi Nguyen
Ocean Associates Corp.
Henry Niemi Jr.
H & M Marine Inc.
Lindgren-Pitman Inc.
All Star Fishery Inc.
Vessel Management Assoc.
Hana Like Inc.
Finback Inc.
Theodore Benjestorf
David B.H. Ho
Pacific Fishing & Supply
Jonathan Lee
Tom C.Y. Kim
Larry DaRosa
Trung Van Ha
Vessel Management Assoc.
Vessel Management Assoc.
Long Thanh Nguyen
Vessel Management Assoc.
B.J. & W.W. Bowyer
Minh Hoang Dang

1998 Western Pacific General Longline Permit

American Samoa Pelagic Fishery

VESSEL	PERMIT HOLDER
F/V 38 SPECIAL	Peter Reid
F/V AAONE	Asaua Fuimaono
F/V ALEUTIAN BEAUTY	Dan Gunn
F/V ALIA O SINA	Afoa Moega Lutu
F/V AMIGO	Jay Vaoalii
F/V CAPTAIN JUSTIN LUTU	Afoa Lures
F/V CLASSIC CAT	Frank Gaisoa
F/V DOS GRIS	George Poysky III
F/V EAGLE II	Steve Haleck
F/V FAISUA	Sui Aveina
F/V FAIVAIMOANA I	Faivaimoana Fishing Co Ltd
F/V FAUVASA	Lemaisu Fesili
F/V FOTOLUPE	Lautogia Taula
F/V FUATINO	Nana Aveina
F/V GREEN PEACE I	Maselino Ioane
F/V GREEN PEACE II	Maselino Ioane
F/V ISABELLA	Jose Lugo
F/V LADY ALVINA	Afoa Moega Lutu
F/V LADY ELINOR	Afoa Lures
F/V LADY GEORGIA	Paepae Simi
F/V LADY HERMINA	Jadran Satalic
F/V LADY LU	Lu's Fish Grotto
F/V LADY POLATAI	Tagaimamao Masaniai
F/V LADY RUTA	Tau Malae
F/V LADYSMITH	Coastal&Offshore Pac Corp
F/V LUPESINA	Maselino Ioane
F/V MAHI MAHI	Lorn Cramer
F/V MALIA	Uili Talimao
F/V MERRY EMMELY	Malua/Henry Nickel
F/V MISS MIHI	Timothy Jones
F/V MONA OF THE OCEAN	Terry Chang
F/V NORTH STAR	Richard Mathisen
F/V NORTHWEST	Harbor Refuse & Environm
F/V OFIRA	Asaua Fuimaono
F/V ORION NO. I	Laszlo Lukacs
F/V PRINCESS DANIELA	Afoa Lures
F/V PTL LIGHT BOAT	Lino Schwenke
F/V RACHEL	Bethel Inc.
F/V RAINBOW RUNNER	Violina Lin
F/V REEL CAT	Dave Haleck
F/V SEA VENTURE	Daniel/Douglas Gunn/Williscroft
F/V SILVER BULLET	David Pedro
F/V SINATALA	Valavala Enosa
F/V SOUTH WIND I	Elvin Mokoma
F/V SOUTH WIND II	Elvin Mokoma
F/V SOUTH WIND III	Elvin Mokoma
F/V SOUTH WIND IV	Elvin Mokoma
F/V TROPIK CAT	Wayne Moors
F/V WILD CAT	Neil/Alfred Annandale

Guam Pelagic Fishery

VESSEL	PERMIT HOLDER
F/V ATALOA	Jim/Nathan Elliott
F/V KARIYUSHI	Guam YTK Corp.
F/V PIONEER	Sunbeam Seafoods Inc.

Commonwealth of the Northern Mariana Islands Pelagic Fishery

VESSEL	PERMIT HOLDER
F/V CHARITO	Renato Azucenas

Hawaii Receiving Vessel Permit

VESSEL	PERMIT HOLDER
F/V NESIKA	Jamie Lee Razov

D. Protected Species Conservation

The Hawaii longline fishery targeting swordfish and tunas has been monitored under a mandatory observer program since February 1994. Beginning March 1994, branch personnel have conducted daily shoreside dock rounds in Honolulu to determine which fishing vessels are in port. These dock rounds are used to obtain an estimate of fishing effort on a real-time basis by assuming that a vessel is fishing when it is absent from the harbor. Approximately 1,180 vessels departed port between January 1, 1998, and December 31, 1998, 48 of which carried observers, representing about 4.1% observer coverage. The following table summarizes protected species interactions for all observed trips that returned during calendar year 1998. Total observed fishing effort was approximately 734,204 hooks and 561 sets; 97 sea turtle and 1 marine mammal interactions were observed.

Loggerhead turtles were the species most often involved in observed interactions (Table 4) with longline gear, followed by leatherbacks and then greens and olive ridleys. Of the 97 turtles observed taken, 69 were released alive, 20 were released injured and 8 released dead (Table 4).

Table 4. Observed longline gear/turtle interactions, 1998

Turtle Species	Condition			
	Released Alive	Released, injured	Dead	Total
Loggerhead	44	16	0	60
Olive Ridley	4	1	2	7
Leatherback	11	1	1	13
Unidentified Hardshell	1	1	2	4
Green	8	1	3	12
Hawksbill	1	0	0	1
TOTAL	69	20	8	97

Estimating total incidental turtle take and mortality for the longline fleet has continued to be a problem for the NMFS Honolulu Laboratory. This is due in part to the low observer coverage (<5%), the rarity of longline-turtle interactions and the different targeting strategies of the elements that comprise the longline fleet. During 1998, the NMFS Honolulu Laboratory produced a report[5] that included the most statistically reliable estimated takes and kills of turtles in the longline fishery based on a classification and regression tree model. These estimates, the allowable take and kill levels, determined from the 1994 biological opinion under Section 7 of

[5]. Kleiber, P. 1998. Estimating annual takes and kills of sea turtles by the Hawaiian longline fishery, 1991-97, from observer program and logbook data. Honolulu Laboratory, Southwest Science Center, National Marine Fisheries Service, NOAA, Administrative Report H-98-08, 15 pp.

the Endangered Species Act, were introduced in 1997, have been updated this year, will continue in future reports and are given in Table 5.

Table 5. Estimated fleet-wide turtle takes and kills in the Hawaiian longline fishery, 1994-1998

Species	Allowable Level	Estimated Takes				
		1994	1995	1996	1997	1998
Loggerhead	305	427	334	390	338	363
95% CL		260-610	242-518	264-537	244-475	262-515
Olive Ridley	152	100	110	114	110	118
95% CL		53-148	59-161	65-167	60-163	65-173
Leatherback	271	154	163	166	172	174
95% CL		102-205	107-218	111-221	114-226	114-231
Green	119	30	31	34	31	35
95% CL		10-51	9-53	12-56	9-53	12-58
Species	**Allowable Level**	**Estimated kills**				
		1994	1995	1996	1997	1998
Loggerhead	46	75	58	68	59	63
95% CL		41-110	41-93	45-98	39-88	43-92
Olive Ridley	41	33	37	38	37	39
95% CL		13-53	15-58	16-60	15-58	15-61
Leatherback	23	10	10	11	11	11
95% CL		0.1-20	0.1-21	0.1-22	0.2-23	0.1-23
Green	18	0.3	0.3	0.3	0.3	0.3
95% CL		0.04-0.62	0.03-0.63	0.05-0.68	0.03-0.64	0.05-0.71

Marine mammal and seabird interactions were also recorded by the observers and are summarized below in Tables 6 and 7.

Table 6. Observed longline gear/marine mammal interactions, 1998			
Marine mammal species	**Condition**		
	Released alive	**Released dead**	**Total**
Monk Seals	0	0	0
Humpback whales	1	0	1
False killer whales	0	0	0
Other whales	0	0	0
Dolphins	0	0	0
Total	1	0	1

Table 7. Observed longline gear/seabird interactions, 1998				
Seabird Species	**Condition**			
	Released alive	**Released Injured**	**Released dead**	**Total**
Albatross	40	15	168	223
Booby	0	0	2	2
Total	40	15	170	225

Concern for the numbers of albatross taken by the Hawaiian longline fleet has been an important concern for the NMFS Honolulu Laboratory. Estimates of total incidental seabird take and mortality for the longline fleet have been determined in the same fashion as were for the turtle takes. Similar problems with low observer coverage (<5%), the rarity of longline-seabird interactions and the different targeting strategies of the elements that comprise the longline fleet exist for these estimates as well. These numbers are based on a similar classification and regression tree model. These estimates and the allowable take and kill levels, determined from the 1994 biological opinion under Section 7 of the Endangered Species Act, were introduced this year and will continue in future reports.

Table 8. Estimated fleet-wide seabird takes in the Hawaiian longline fishery, 1994-1998

Species	Estimated takes				
	1994	1995	1996	1997	1998
Blackfooted albatross	1994	1979	1568	1653	1963
95% CI	1508-2578	1439-2497	1158-1976	1243-2101	1479-2470
Laysan albatross	1828	1457	1047	1150	1479
95% CI	933-2984	767-2308	569-1610	599-1875	822-2336

E. USCG Enforcement Activities

The U.S. Coast Guard conducted 753 hours of fisheries patrols with C-130 aircraft in the Central and Western Pacific during 1998. Almost 300 days of surface patrols were also conducted. The Coast Guard patrol effort in the eight non-contiguous EEZs was broken down as follows:

Table 9. USCG patrol effort in the Western Pacific Region

EEZ Area	Surface Patrol Days	Aircraft Patrol Hours
Main Hawaiian Islands	65	121
Northwest Hawaiian Islands	9	42
Guam and Northern Mariana Islands	135	329
Johnston Atoll and Wake Island	10	17
American Samoa	6	30
Palmyra Atoll/Kingman Reef	10	40
Jarvis Island	10	51
Howland & Baker Islands	43	123

There were also 58 hours flown in direct support of international High Seas Driftnet (HSDN) enforcement. The USCG flew over 300 hours with HH-65 helicopters in support of fisheries operations; this effort was concentrated in the main Hawaiian Islands and while deployed on high endurance cutters.

In 1998, there were 278 total fishing vessel boardings in the USCG 14th District AOR. The breakdown of vessels boarded is as follows: 182 were American, 40 were Japanese, 28 were Taiwanese, 9 were South Korean, and 19 were of other nationalities.

There were no significant fisheries enforcement cases involving foreign fishing vessels in 1998.

Vessel Monitoring System

The NMFS OLE currently operates a satellite-based fishing vessel monitoring system to help determine the location and activity of vessels fishing around the Hawaiian Islands. VMS can also be used to receive catch and effort data from the fleet, transmit and receive messages, and accurately locate vessels during an emergency. While VMS is currently used only for fisheries around the Hawaiian Islands, the system has potential uses in other fisheries throughout the Western Pacific, where the United States exercises jurisdiction over about 1.5 million square miles of ocean.

The Hawaii Vessel Monitoring System (VMS), monitored in the 14th District Command Center by NMFS and USCG, continues to be an effective surveillance and enforcement tool. In 1998, there were nine significant enforcement cases cued by the VMS information. Using "signature analysis" USCG and NMFS identify possible incursions into the main Hawaiian Island (MHI) longline closure area and the Northwest Hawaiian Island (NWHI) Protected Species Zone (PSZ).

This information is passed to patrolling cutters for investigation during at-sea enforcement boarding. The following information applies:

The following violations by fishing vessels were observed during 1998:

On 4 January, Coast Guard and NMFS detected an incursion into the Protected Species Zone around Gardiner Pinnacle and French Frigate Shoals in the NWHI on the Hawaii VMS by the F/V PAN AM II, a Hawaii longliner. The Coast Guard monitored the movement of the PAN AM II and detected a second incursion into the PSZ on 7 January.

On 20 January, the CGC ASSATEAGUE boarded the vessel and documented the violations. The Offense Investigation Report was forwarded to NMFS for disposition.

While patrolling the American Samoa EEZ, CGC SASSAFRAS boarded four Pago Pago-based domestic longliners or alias. No fisheries violations were found; however, the alias compliance with federal Commercial Fishing Vessel Safety Regulations varied widely between the four. In one case, the voyage of the GREENPEACE III was terminated and the vessel was escorted back to Pago Pago. The other three alias had minor or no violations.

While on a Central Pacific patrol on 17 February, CGC SASSAFRAS sighted the FFV SHIN YUNG No. 55 actively fishing in the Kiribati EEZ around Canton Island. The Fourteenth District routinely forwards sighting information collected in the course of normal operations to the Forum Fisheries Agency (FFA). In this case, the Fisheries Enforcement Unit in Kiribati reported that this vessel had not checked into their EEZ and a violation would be issued.

On 30 April, Coast Guard and NMFS detected an incursion into the Protected Species Zone in the NWHI on the Hawaii VMS by the F/V BLUE DRAGON, a Hawaii longliner. The Coast Guard monitored the movement of the vessel until its return to port. A NMFS enforcement agent boarded the vessel at the dock.

On 1 May, Coast Guard and NMFS detected an incursion into the Main Hawaiian Island longline closure area on the Hawaii VMS by the F/V PETITE ONE, a Hawaii longliner. The Coast Guard monitored the movement of the vessel until its return to port. A NMFS enforcement agent boarded the vessel at the dock.

On 9 May, Coast Guard and NMFS detected an incursion into the Main Hawaiian Island longline closure area on the Hawaii VMS by the F/V CRYSTAL, a Hawaii longliner. The Coast Guard monitored the movement of the vessel until its return to port. A NMFS enforcement agent boarded the vessel at the dock.

On 12 June, Coast Guard and NMFS detected an ongoing incursion into the Protected Species Zone in the NWHI on the Hawaii VMS by the F/V CAPT GREG. The Coast Guard monitored the movement of the vessel and determined that the CAPT GREG was

currently setting gear in the Protected Species Zone. A C-130 from Barber s Point was launched and documented the illegal activity. A case package was developed and forwarded to NMFS enforcement for disposition.

On 28 October, the F/V LADY ALICE (US) was identified on the Vessel Monitoring System (VMS) as possibly longline fishing inside the Main Hawaiian Island Longline Closed Area. CGC ASSATEAGUE boarded the LADY ALICE on 29 October and found that the vessels logbook confirmed the violation. A second violation for improperly maintained lob book was issued.

Meetings and Conferences

Throughout 1998, the 14th District Law Enforcement Branch actively participated in meetings and conferences in support of the protection of living marine resources. These events ranged from informal gatherings of fisheries enforcement officials to our participation in the Multilateral High Level Conference (MHLC) on Highly Migratory Species. The Coast Guard was also asked to become a full member of the South Pacific Forum Fisheries Agency (FFA) Monitoring, Control, and Surveillance Working Group. In addition, in 1998, the Coast Guard executed five combined exercises under Operation PACIFIC COMPASS. Operation PACIFIC COMPASS is a recurring Cooperative Maritime Patrol and Self-Support Operation involving Coast Guard cutters and aircraft, Pacific Island country patrol boats, and Australian and New Zealand maritime surveillance aircraft. The purpose of Operation PACIFIC COMPASS is to expand the 14th District's partnership with regional fisheries enforcement counterparts in support of US national goals.

F. NMFS enforcement activities

Special Agents of NMFS, Office for Law Enforcement (OLE) conduct investigations of alleged violations of NOAA statutes and regulations, including the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA), the Lacey Act, the Marine Mammal Protection Act and the Endangered Species Act. During 1998, Special Agents were assigned to Honolulu, Hawaii; Pago Pago, American Samoa; Agana, Guam; and Honiara, Solomon Islands. The Guam agent responded to complaints in the Northern Marianas Islands and the Honiara Agent assisted nations that are members of the Forum Fisheries Agency.

During 1998, 125 longline vessels fished in the Western Pacific Pelagic Fisheries, primarily for tuna and swordfish. In order to participate in these fisheries, vessels were required to have a limited entry permit and to carry on board a Vessel Monitoring System (VMS). Vessels were also subject to a requirement to carry an observer. The regulations imposed reporting requirements on participants and closed approximately 160,000 square nautical miles around the northwest and main Hawaiian Islands to longlining to help protect fishery stocks, and also to protect endangered species that occur in the region, particularly the Hawaiian monk seal. During the year the OLE documented 52 apparent violations of the Western Pelagic Fisheries regulations.

Statistics for 1998

Complaints received	151
Dockside boardings conducted in Honolulu	160
Dockside boardings conducted in American Samoa	132
Fisheries investigations opened	68

Territory of American Samoa

Introduction

The pelagic fishery in American Samoa has historically been an important component of the traditional domestic fisheries. The fishery was first monitored in the mid 1970s and has operated on a similar small scale since that time. Prior to 1985, only commercial landings were monitored. From October 1985 to the present, data were collected through a creel survey that included subsistence and recreational fishing as well as commercial fishing. In 1998, 47 vessels participated in the fishery.

Prior to 1995 the pelagic fishery was largely a troll-based fishery. In mid-1995 four vessels began longlining and in 1997, 33 vessels had permits to longline: approximately 17 of those were actively fishing on a monthly basis. This year 50 local vessels received federal permits to longline but only 26 did longline. The horizontal method of longlining was introduced to the Territory by Western Samoan fishermen a few years ago. The local fishers have found longlining to be a worthwhile venture to engage in because they land more pounds with less effort and use less gas for trips. Apart from a couple of bigger (>40ft) inboards participating, the vessels most frequently used are the "alias", twin-hulled (wood with fiberglass or aluminum) boats about 30 feet long, and powered by small gasoline outboard engines. Navigation on the alias is visual, using landmarks. The gear is stored on deck attached to a hand-crank reel which can hold as much as 10 miles (25 miles for the jig-boat) of monofilament mainline. The gear is set by spooling the mainline off the reel and retrieved by hand-cranking the mainline back onto the reel. Trips are about a day long (about 8 hours). Setting the equipment generally begins in the early morning; haulback is generally in the mid-day to afternoon. The catch is stored in containers secured to the deck, or in the hulls. Albacore tuna is the primary species caught, and is generally stored in personal freezers until a sufficient amount is accumulated to sell to the canneries. Some of the catch is also sometimes sold to stores, restaurants, local residents and donated for family functions. One of the two biggest inboards lands its catches at the canneries and these landings are not included in this report but could be in future reports.

The island of Tutuila is also a major base for the trans-shipment and processing of tuna taken by the Distant-waters longliner and purse seine fleets. The domestic pelagic fishery is monitored by the Department of Marine and Wildlife Resources (DMWR), through a program established in conjunction with the Western Pacific Fishery Information Network (WPacFIN). This report was prepared by DMWR using information obtained by surveying domestic pelagic fishing activities throughout the year. Except for the last figure (Figure 14) it does not contain data on Distant-waters landings at the canneries. Fishing Tournament information is also not included in this report. This report partially fulfills the national standard requirement for a Stock Assessment and Fishery Evaluation (SAFE) report.

Summary

Data for the period 1996-1998 was re-expanded, incorporating needed parameters so as to provide better representation and estimates of all offshore gear types. This was necessary in light of the relatively new longline fishery. Appropriate expansion algorithms were also used to accommodate minor changes in the sampling methodologies. Subsequently, trends in this years report shouldn't be compared to past Plan Team annual reports.

During 1998, a slight increase in total landings was recorded (Figure 1) along with significant drops in trolling effort. The trolling catch per unit effort (CPUE) was the lowest since 1982 but was only about 17% less than the previous 5 years average. Prices for pelagic species remained relatively low in 1997 and slightly increased this year. Local longlining this year recorded 32 fish per 1000 hooks and an average 40.1 pounds per fish.

This year, only 26 vessels longlined out of a total 50 boats that received federal longline permits. Local boats have been targeting albacore mostly for the cannery market and have caused the albacore harvest to increase more than 100% during 1996 to 1997. This year, a slight increase in albacore landings was recorded. Total landings, however, will increase significantly when landings of the biggest domestic inboard longliner are included in future reports.

1997 Recommendations and **current status**:

1. Continue efforts to monitor the pelagic fisheries of the local fleet in American Samoa.

On-going Offshore Creel Survey continued to monitor the domestic pelagic fisheries with ample three days per week sampling schedule.

2. Closely monitor the longline fleet operating in the fishery.

Longline vessels operations are being closely monitored through the above-mentioned Offshore Creel Survey and the Federal logbook system.

3. Incorporate and compare longline fisheries data from the logbooks and the creel survey.

Preliminary analysis and comparison between these two systems have been done in conjunction with the central WPacFIN program but problems with vessel identification and algorithms to deal with the expanding longline fisheries need to be addressed. A lot of related problems, however, have been resolved and will continue to be settled with WPacFIN assistance.

4. Continue to work with Central WPacFIN to develop new data expansion algorithms to incorporate longline fishing as a new stratum in the offshore survey.

Longline fishery has always been a stratum of the Offshore Survey but data specific to that fishery wasn't presented separately within these reports in the past and has confused past presenters of this module. Preliminary precursory algorithms were utilized for the 1996-1998 data for this report and a new data processing system is currently being developed by WPacFIN to better address this issue.

1998 Recommendations:

1. Integrate creel survey and federal logbook data to provide a more complete picture of the domestic longline fishery, preferably in next years report.
2. Add CPUE comparison between creel survey and log book data in future reports.
3. Continue to work with WPacFIN to improve and implement algorithms that better represent all the offshore fisheries in American Samoa.

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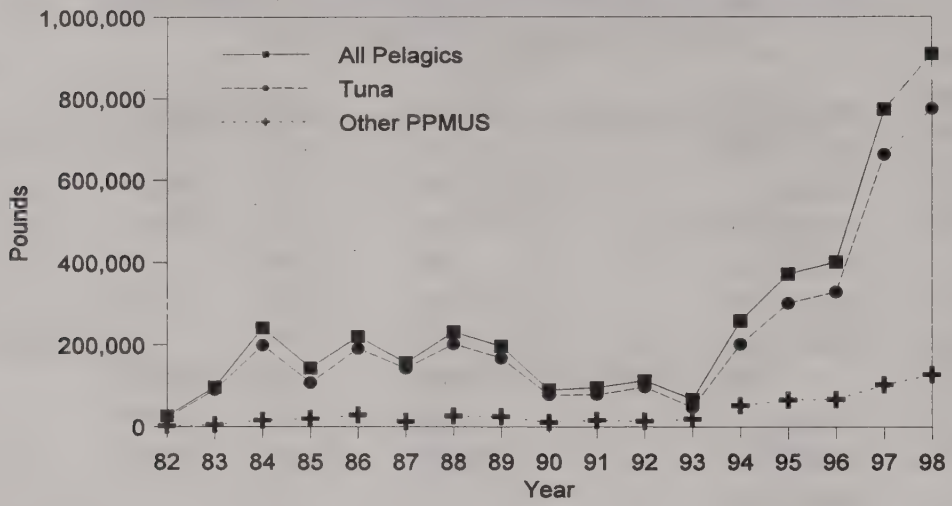
Table 1. American Samoa 1998 estimated total landings for pelagic species by gear type

Species	Longline Pounds	Troll Pounds	Total Pounds
Skipjack Tuna	35306	18767	54073
Albacore	637821	0	637821
Yellowfin Tuna	73942	1110	75052
Kawakawa	0	82	82
Bigeye Tuna	5695	0	5695
Unidentified Tunas	366	0	366
Subtotal Tunas	**753130**	**19959**	**774695**
Mahimahi	30021	940	30961
Black Marlin	0	0	0
Blue Marlin	41203	894	42097
Wahoo	36017	235	36252
Dogtooth Tuna	114	554	668
Sharks	7196	208	7404
Swordfish	3231	142	3373
Sailfish	6604	97	6701
Subtotal other PPMUS	**124386**	**3070**	**127456**
Barracuda	4145	1616	5761
Rainbow Runner	744	402	1146
Moonfish (Opah)	1749	224	1973
Subtotal Misc.	**6638**	**2242**	**8880**
Total Pelagics	**884154**	**25271**	**909425**

Table 2. American Samoa 1998 estimated commercial landings, value and average price of pelagic species.

Species	Pounds	$/lb	Value ($)
Skipjack Tuna	16672	0.91	15172
Albacore	636,622	1.07	683,254
Yellowfin Tuna	67,249	1.91	128655
Kawakawa	20	1.20	24
Bigeye Tuna	5,478	2.14	11741
Other Tunas	366	1.00	366
Subtotal Tunas	**726484**	**1.16**	**839730**
Mahimahi	22220	2.01	44560
Blue Marlin	35,646	1.13	40,268
Black Marlin	0	0	0
Wahoo	26,110	1.95	51,042
Dogtooth Tuna	401	1.84	738
Swordfish	3326	3.57	11880
Sailfish	3327	1.49	4967
Subtotal other PPMUS	**91029**	**1.69**	**153453**
Barracudas	2120	2.17	4598
Sharks	0	0	0
Rainbow Runner	783	1.00	783
Moonfish (Opah)	443	2.00	887
Subtotal Misc.	**3346**	**1.72**	**6268**
Total Pelagics	**820783**	**1.22**	**998,930**

Figure 1. American Samoa total annual landings: all pelagics, tuna and other PPMUS

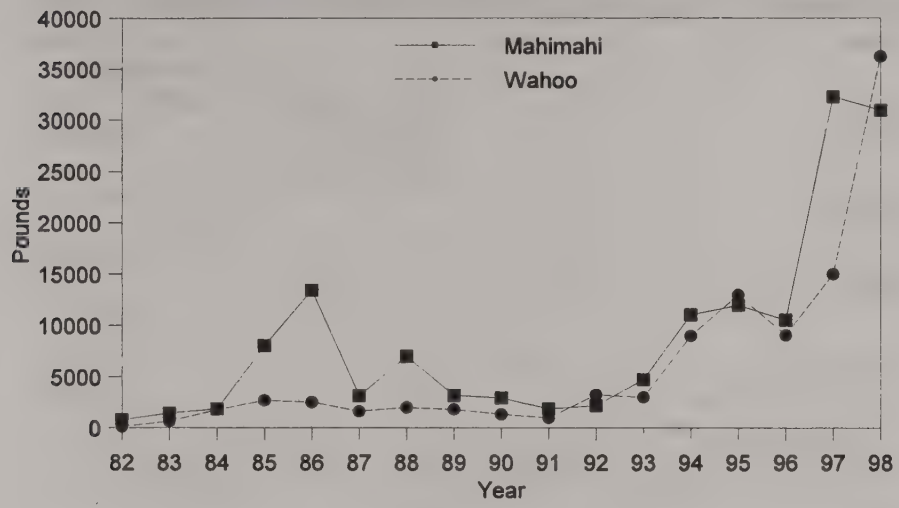


Interpretation: Total landings nearly doubled in 1997 but only increased about 20% this year. Most of this years increase is due to increase in longline effort (Figure 7). The biggest inboard domestic longliner's landings are not included in this report as it lands its catch at the canneries. The creel survey from which data are collected for this report, does not sample cannery landings. Inclusion of these landings in future reports will significantly increase total landings.

Calculation: Estimated landings for tuna and other PPMUS were calculated by summing the total landings for the species in each category. Estimated landings for all pelagics represent the sum of tuna and other PPMUS plus landings from the miscellaneous category (see Table 1). These figures include both commercial and recreational/subsistence components of the fishery.

	Pounds Landed		
Year	**All Pelagics**	**Tuna**	**Other PPMUS**
1982	26,396	23,042	2,106
1983	96,318	90,057	4,806
1984	241,099	198,961	15,121
1985	143,212	107,656	19,686
1986	220,063	190,621	28,046
1987	155,324	142,155	12,798
1988	230,951	201,404	25,972
1989	195,563	166,922	24,253
1990	89,240	77,213	10,288
1991	95,009	78,033	15,129
1992	111,914	96,701	13,054
1993	67,037	46,757	18,498
1994	257,859	201,097	51,672
1995	372,179	300,844	65,050
1996	401,182	328,413	66,680
1997	773,160	662,396	101,913
1998	909,425	774,695	127,456
Average	**257,996**	**216,880**	**35,443**

Figure 2. American Samoa annual landings: mahimahi and wahoo

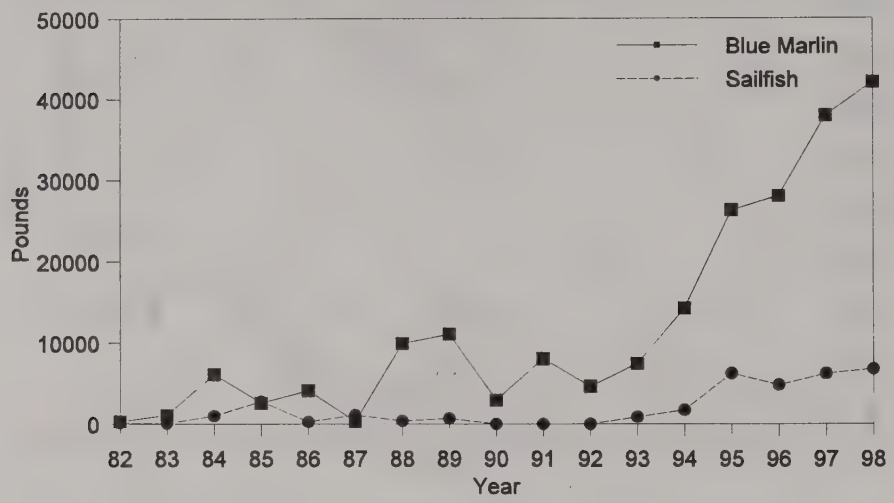


Interpretation: Mahimahi landings are variable across time, similar fluctuations occur in other WPACFIN regions. From 1984 - 1988 American Samoan fishermen exported mahimahi to Hawaii so landings were uniquely high. 1997 mahimahi landings are the largest since then, due to the influx in longlining starting in 1995. Longliners took in 97% of the mahimahi this year (Table 1). Wahoo landings have increased notably since 1996 and the increase in 1997 is due to the increase in longlining trips. Longlining brought in more than 99% of the wahoo this year.

Calculation: Estimated landings for mahimahi and wahoo are summed for all fishing methods.

	Pounds Landed	
Year	**Mahimahi**	**Wahoo**
1982	777	114
1983	1,443	632
1984	1,844	1,777
1985	8,011	2,678
1986	13,435	2,492
1987	3,144	1,609
1988	6,976	1,981
1989	3,179	1,804
1990	2,913	1,320
1991	1,890	952
1992	2,174	3,244
1993	4,722	3,007
1994	11,048	9,000
1995	11,982	12,975
1996	10,521	9,052
1997	**37,299**	**14,999**
1998	**30,961**	**36,252**
Average	**8,960**	**6,111**

Figure 3. American Samoa total annual landings: blue marlin and sailfish

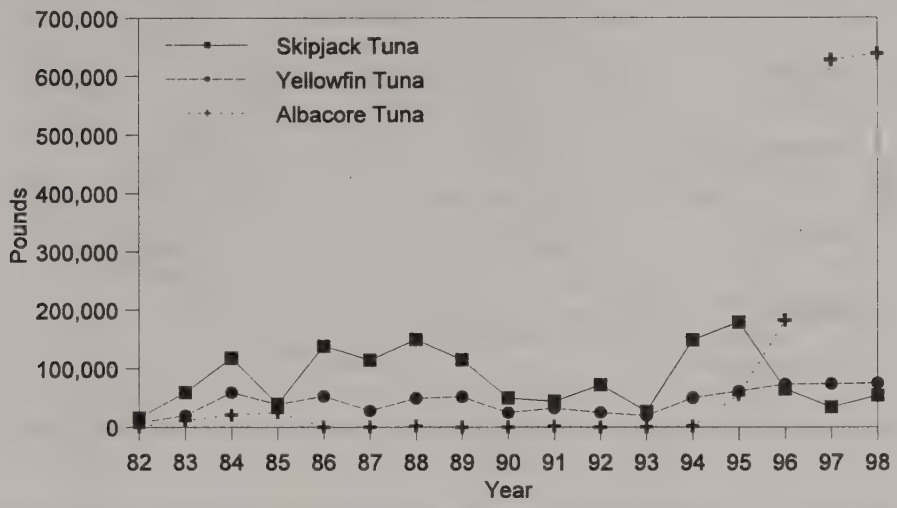


Interpretation: Increases in blue marlin landings for 1997 and this year are probably due to increased longlining effort, with longlining taking >90% of the marlin this year. Sailfish are caught more by longlining (56% in 1996 and about 100% in 1997 and 1998), which may explain the general increase in 1995-1997, a period of influx longlining.

Calculation: The estimated total yearly landings of blue marlin and sailfish are summed for all fishing methods.

	Pounds Landed	
Year	**Blue Marlin**	**Sailfish**
1982	315	127
1983	1,083	74
1984	6,097	989
1985	2,574	2,744
1986	4,108	271
1987	297	1,081
1988	9,892	367
1989	11,047	687
1990	2,946	0
1991	8,012	0
1992	4,628	0
1993	7,404	873
1994	14,223	1,705
1995	26,268	6,184
1996	28,030	4,802
1997	37,968	6,173
1998	**42,097**	**6,701**
Average	**12,176**	**1,928**

Figure 4. American Samoa total annual landings: skipjack, albacore and yellowfin tuna

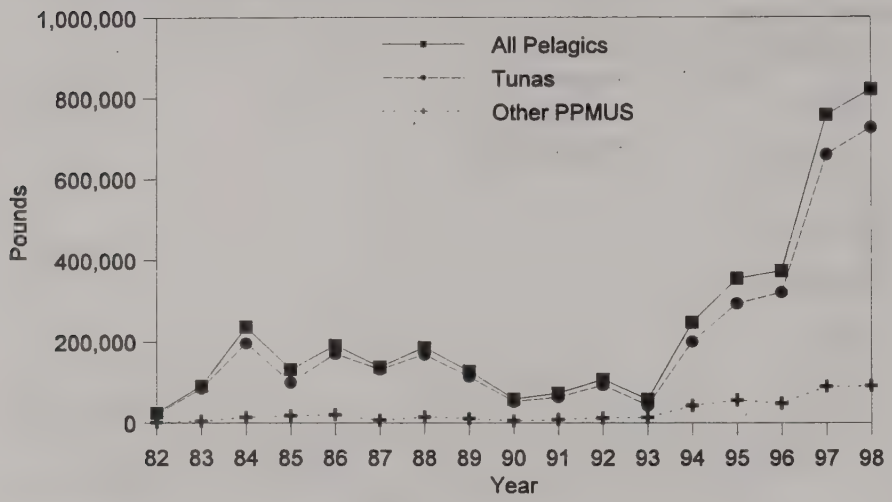


Interpretation: Recent notable increased albacore landings are due to the increase in longlining effort that began in 1995. Longlining took 100% of the albacore during 1995 and 1996 and 99.9% in 1997. Prior to that time, albacore was taken at low levels during occasional longlining trips. 1997 decreases in skipjack landings are probably due to the decrease in troll fishing. This years increases of yellowfin tuna may be due to increase in longlining effort -- more than 90% of the yellowfin were taken by longliners this year.

Calculation: The estimated yearly total landings of skipjack, yellowfin and albacore tuna are summed for all fishing methods.

	Pounds Landed						
Year	**Skipjack**	**Yellowfin**	**Albacore**	**Year**	**Skipjack**	**Yellowfin**	**Albacore**
1984	117,693	58,704	20,390	1991	43,888	32,225	1,672
1985	38,902	38,586	24,821	1992	71,677	24,722	0
1986	138,064	52,464	0	1993	26,616	19,775	236
1987	114,381	27,627	0	1994	148,382	50,124	1,802
1988	149,416	49,159	1,884	1995	179,104	60,952	54,902
1989	114,805	51,383	0	1996	64,758	73,539	182,193
1990	49,613	24,565	0	1997	34,207	73,793	627,581
				1998	**54,073**	**75,052**	**637,821**
				Average	**89,705**	**47,511**	**103,554**

Figure 5. American Samoa annual commercial landings: all pelagic species, tunas and other PPMUS

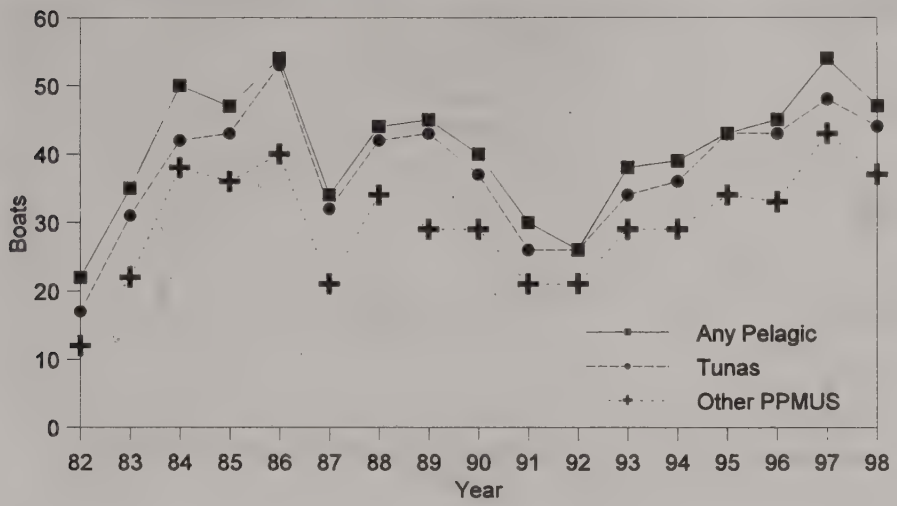


Interpretation: Commercial landings represent 99% of the landings for pelagic species in 1997, and about 90% this year, thus Figures 5 and 1 are virtually identical, as are the interpretations. Much of the increase in landings since 1995 is due to a surge in the longlining effort.

Calculation: Estimated commercial landings for tunas and other PPMUS were calculated by summing commercial landings for the species in each category. Estimated landings for all pelagics represent the sum of tunas and other PPMUS plus landings for the miscellaneous category (see Table 1).

	Pounds Landed		
Year	**All Pelagics**	**Tunas**	**Other PPMUS**
1982	24,820	22,065	1,515
1983	90,744	85,069	4,441
1984	236,216	196,100	13,458
1985	131,310	99,987	17,515
1986	190,998	169,986	19,949
1987	137,925	131,457	6,305
1988	185,432	168,826	14,210
1989	127,560	113,904	10,745
1990	58,089	52,111	4,903
1991	73,044	63,607	8,096
1992	106,299	92,381	11,759
1993	57,184	42,573	12,945
1994	247,347	199,681	42,589
1995	355,305	293,571	55,826
1996	373,694	659,902	47,684
1997	757,847	726,484	89,438
1998	**820,783**	**726,484**	**91,029**
Average	**233,800**	**226,129**	**26,612**

Figure 6. Number of American Samoa boats landing any pelagic species, tunas and other PPMUS

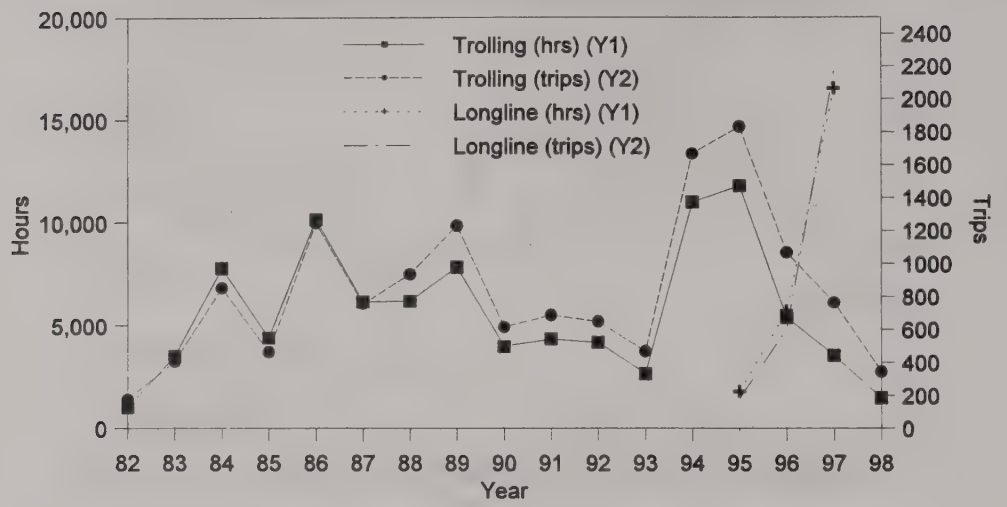


Interpretation: The number of boats participating in the pelagic fishery increased by 20% in 1996. Ten boats began longlining that year. In 1998, only 26 boats used longline gear from a total of 50 that received federal permits.

Calculation: The sampling program is extensive enough, and the number of boats small enough, to use raw database counts of the number of vessels in a given year. Each boat counted here made at least one recorded landing of at least one pelagic species during a given year.

	Number of Boats landing:		
Year	**Any Pelagic**	**Tunas**	**Other PPMUS**
1982	22	17	12
1983	35	31	22
1984	50	42	38
1985	47	43	36
1986	54	53	40
1987	34	32	21
1988	44	42	34
1989	45	43	29
1990	40	37	29
1991	30	26	21
1992	26	26	21
1993	38	34	29
1994	39	36	29
1995	43	43	34
1996	45	43	33
1997	54	48	43
1998	47	44	37
Average	**41**	**38**	**30**

Figure 7. American Samoa fishing effort for pelagic species



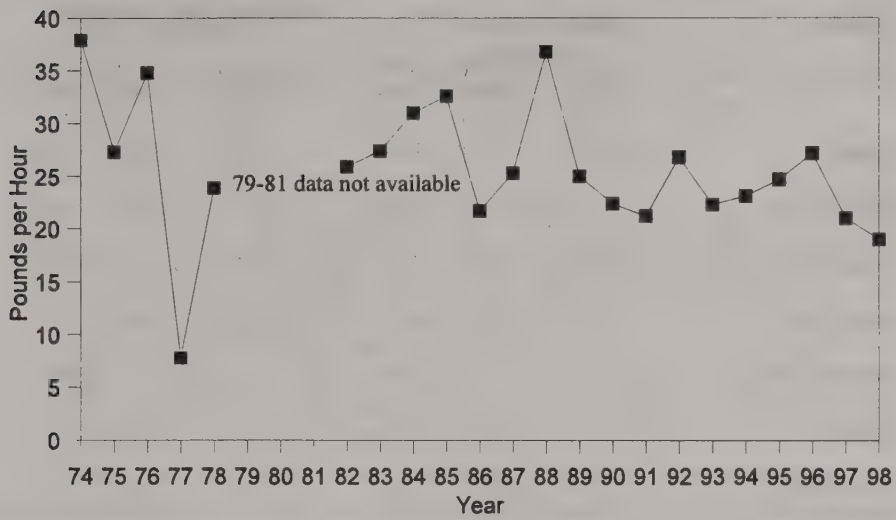
Interpretation: Trolling trips decreased by 70% while longline trips increased by about 20%. Trolling effort decline is an effect of the switch-over by vessels from trolling to the more profitable longline fishing.

Calculation: For 1982 to 1994 estimated total annual landings are used as a base for estimating trolling effort. The resultant number is divided by the average trolling catch per hour (CPUE) to give an estimate of the hours trolled. Trolling CPUE is calculated using only those trips where trolling was the only method used, and for which the number of hours was recorded. The number of trips is calculated by dividing the estimated total hours of effort by the average length of a trolling trip. For 1995, 1996 and 1997 total longline landings were subtracted from the total landings prior to using the above calculation, standardizing non-longline effort to trolling effort.

Estimated Fishing Effort

	TROLLING			HOURS		TRIPS	
Year	Hours	Trips	Year	Trolling	Longline	Trolling	Longline
1982	1,019	177	1989	7,838		1,231	
1983	3,513	406	1990	3,977		615	
1984	7,785	853	1991	4,342		688	
1985	4,394	464	1992	4,178		650	
1986	10147	1247	1993	2,660		467	
1987	6149	757	1994	10,989		1,670	
1988	6181	936	1995	11,791	1,853	1,834	189
			1996	5,383	6,018	1,068	635
			1997	3,545	14,927	764	1,963
			1998	636	18,691	123	2,359
			Average	**5,560**	**10,372**	**821**	**1,287**

Figure 8. American Samoa overall pelagic catch per hour trolling



Interpretation: Total pelagic species CPUE is predominantly the combined skipjack and yellowfin CPUE shown in Figure 10, as these two species contributed about 75% of the total troll catch. 1998 CPUE was lower than 1997 due to decreased CPUEs for most species caught by trolling (Figs. 9 and 10). Pelagic species CPUE has been variable, especially in the early years of the American Samoa troll fishery. The 1997-1998 decline in # trips observed during this year reflects the decline in the number of boats participating (Figure 6) together with a slight decrease in catch/hr .

Calculation: For trips where trolling was used exclusively, and where effort was recorded, the total catch was divided by the total number of trolling hours to obtain CPUE. Data are from three sources; 1974-78 are from the Dory Project, 1982-84 are from the commercial catch monitoring system, and 1985-97 are from the creel survey program.

Year	lb../Hr	Trips	Year	Lb./Hr	Trips
1974	37.9	31	1987	25.3	215
1975	27.3	98	1988	36.8	276
1976	34.8	10	1989	24.9	359
1977	7.8	6	1990	22.4	280
1978	23.9	96	1991	21.2	203
1982	25.9	104	1992	26.8	204
1983	27.4	156	1993	22.3	213
1984	31	311	1994	23.1	379
1985	32.6	193	1995	24.7	460
1986	21.7	397	1996	27.2	357
			1997	21.0	298
			1998	**19.0**	**214**
			Average	**25.7**	**221**

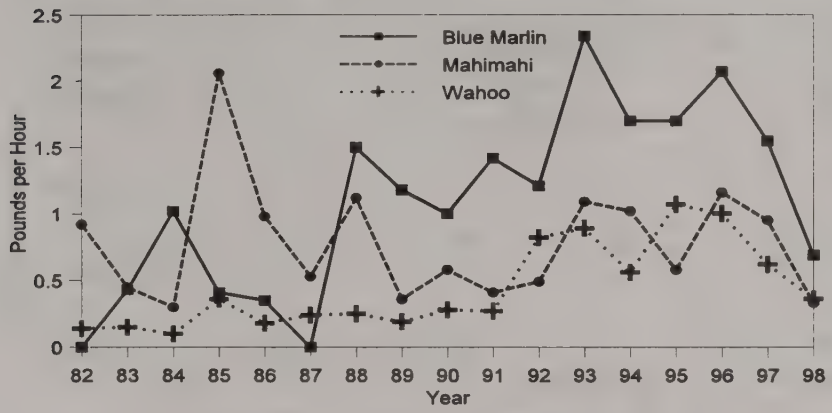
Table 3. American Samoa 1996 - 1998 estimated catch rates by species for the longline fishery.

Species	Number fish per 1,000 hooks			Average lbs. per fish		
	1996	1997	1998	1996	1997	1998
Albacore	30.91	31.18	20.3	40.0	43.9	45.5
Skipjack Tuna	0.30	0.60	3.9	9.6	8.4	12.4
Yellowfin Tuna	4.09	2.51	2.3	37.9	43.9	46.4
Bigeye Tuna	1.05	0.14	0.11	52.3	82.8	79.2
Dogtooth Tuna			0.01			10.0
Mahimahi	1.25	2.81	1.84	26.3	25.6	23.2
Blue marlin	0.90	0.61	0.49	151.8	118	119
Wahoo	0.53	0.85	2.01	43.0	38.1	26.3
Sharks	0.40	0.18	0.09	109.4	98.9	114
Swordfish	0.03	0.01	0.02	150.0	100	213
Moonfish			0.07			33.5
Sailfish	0.20	0.22	0.14	88.4	69.0	67
Barracuda	0.58	0.29	0.41	13.5	15.4	15.3
Miscellaneous	0.10	0.03	0.08	61.8	59.8	19.7

The longline fishery in American Samoa is a newly emerging fishery since 1995. In 1995 four boats longlined in AS waters, 13 boats longlined in 1996, 22 in 1997 and 26 boats used this method this year. From 1996 to 1997 in American Samoa there was not a great deal of change in catch rates or average sizes of fishes. There was, however, a notable decrease in yellowfin catch rate, but an increase in the average size. In 1998 catch rates for albacore decreased with an increase in average size. With only three years for comparisons, it is difficult to look at natural variation and other fishery-related factors. Notable increase in total catch may not be attributed to an increase in CPUE, but to the increase in fishing effort.

Calculation: Total number of hooks set on the total number of sampling trips were summed then total number of fishes caught enumerated. Species CPUEs were taken from data collected during the sampling trips: the number of the species caught were divided by the number of hooks used to catch them and then multiplied by 1,000. Average pounds per species were calculated by dividing the number of total pounds of that species by the number of fish of that species caught.

Figure 9. American Samoa trolling catch rates: blue marlin, mahimahi and wahoo

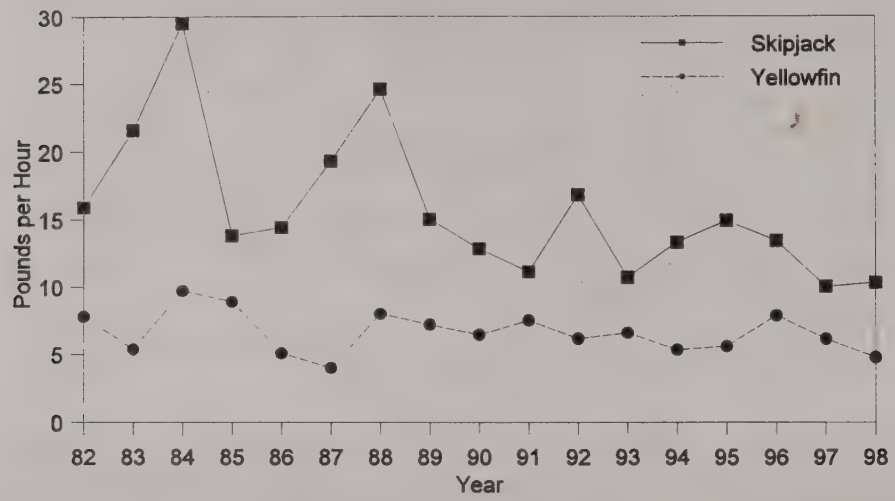


Interpretation: Blue marlin CPUE is variable but has increased over time. The variability is probably due to small number of fish taken, while the general increase in CPUE is probably due to gear and boat improvements. Mahimahi CPUE peaked in the mid eighties, when an export market existed for this species. Since that time, mahimahi CPUE has been variable, and without obvious trend. Wahoo CPUE has also increased over time, the reason for this increase is unknown. Although there was a decrease in CPUE for all species here, the values all remain above the 16-year average.

Calculation: For trips where trolling was used exclusively, and where effort was recorded, the total catch by species was divided by the total number of trolling hours to obtain CPUE.

	Pounds Caught per Hour Trolling		
Year	**Blue Marlin**	**Mahimahi**	**Wahoo**
1982	0.00	0.92	0.14
1983	0.43	0.45	0.15
1984	1.02	0.30	0.10
1985	0.41	2.06	0.36
1986	0.35	0.98	0.18
1987	0.00	0.53	0.24
1988	1.50	1.12	0.25
1989	1.18	0.36	0.19
1990	1.00	0.58	0.28
1991	1.42	0.41	0.27
1992	1.21	0.49	0.82
1993	2.34	1.09	0.89
1994	1.70	1.02	0.56
1995	1.70	0.58	1.07
1996	2.07	1.16	1.00
1997	1.55	0.95	0.62
1998	**0.69**	**0.33**	**0.36**
Average	**1.12**	**0.81**	**0.45**

Figure 10. American Samoa trolling catch rates: skipjack and yellowfin tuna

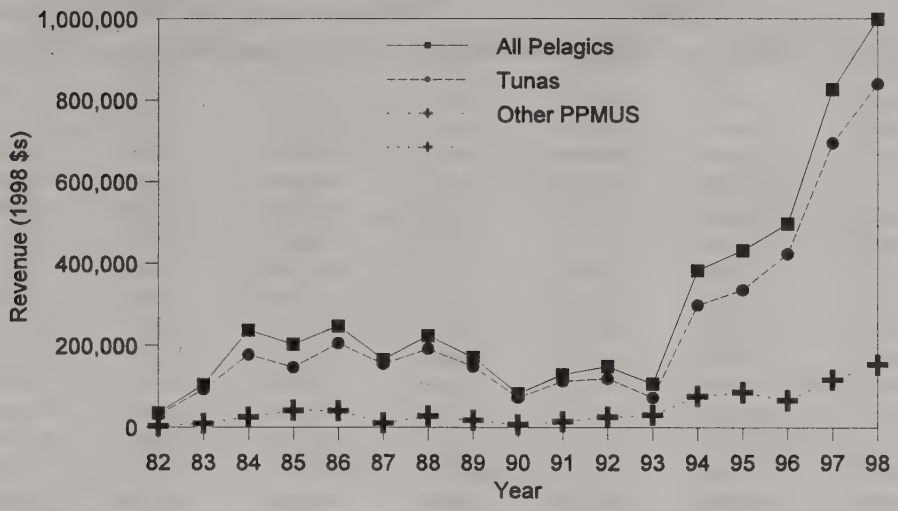


Interpretation: Skipjack CPUE has been highly variable through the years with a declining trend. This year it is well below the 16-year average. Yellowfin tuna CPUE has been fairly stable over time, and remains close to the average catch rate.

Calculation: For trips where trolling was used exclusively, and where effort was recorded, the total catch by species was divided by the total number of trolling hours to obtain CPUE.

	Pounds Caught Per Hour Trolling	
Year	**Skipjack**	**Yellowfin**
1982	15.9	7.8
1983	21.6	5.4
1984	29.5	9.7
1985	13.8	8.9
1986	14.4	5.1
1987	19.3	4.0
1988	24.6	8.0
1989	15.0	7.2
1990	12.8	6.5
1991	11.1	7.5
1992	16.8	6.2
1993	10.7	6.6
1994	13.0	5.4
1995	14.9	5.6
1996	13.4	7.9
1997	10.0	6.1
1998	**10.3**	**4.8**
Average	**15.71**	**6.63**

Figure 11. American Samoa annual inflation-adjusted revenue for commercially landed pelagic species



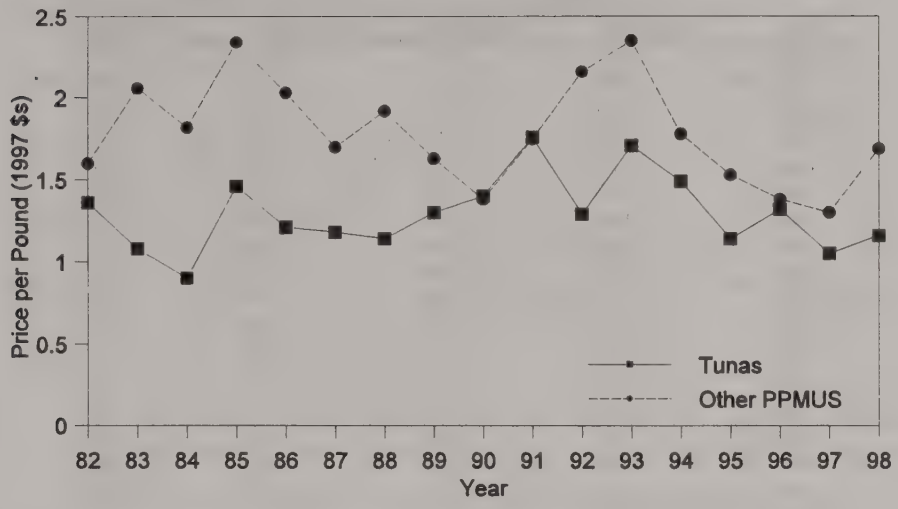
Interpretation: Revenues for commercial landings of all pelagic species about double in 1997 but with only a 20% increase this year. Fishermen actually received less per pound for tunas in 1997 than recent years (Figure 12), but because of the huge increase in catch, many more fish were sold than in previous years, thus revenues increased accordingly. The slight increase this year parallel a similar increase (about 18%) in total pelagic landings and about 14% increase in albacore landings.

Calculation: Revenues from commercial landings for all pelagic species are adjusted for inflation by multiplying a given year's revenue by the quotient of the 1998 consumer price index (CPI) divided by the CPI for that year.

[data on following page]

	Revenue ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjust.	Adjusted	Unadjust.	Adjusted	Unadjust.	Adjusted
1982	21,824	34,482	18,990	30,004	1,534	2,424
1983	66,254	104,019	58,561	91,941	5,828	9,150
1984	153,571	236,499	114,981	177,071	15,938	24,545
1985	131,961	201,900	95,157	145,590	26,800	41,004
1986	166,851	246,939	138,498	204,977	27,311	40,420
1987	116,564	165,521	108,816	154,518	7,527	10,688
1988	163,189	223,568	139,902	191,666	19,940	27,317
1989	129,460	170,887	111,923	147,739	13,269	17,515
1990	66,865	81,575	59,747	72,891	5,554	6,776
1991	110,275	129,022	95,936	112,245	12,083	14,137
1992	132,899	148,847	106,260	119,011	22,629	25,344
1993	94,707	106,071	64,890	72,677	27,113	30,366
1994	348,401	383,242	271,170	298,287	68,993	75,892
1995	400,140	432,151	310,815	335,680	78,880	85,190
1996	478,004	497,124	407,483	423,782	63,416	65,952
1997	**818,436**	**826,620**	**688,052**	**694,933**	**114,718**	**115,866**
1998	**998,929**	**998,929**	**839,731**	**839,731**	**153,452**	**153,452**
Average	**258,725**	**293,376**	**213,583**	**241,926**	**39,117**	**43,885**

Figure 12. American Samoa average inflation-adjusted price for tunas and other PPMUS



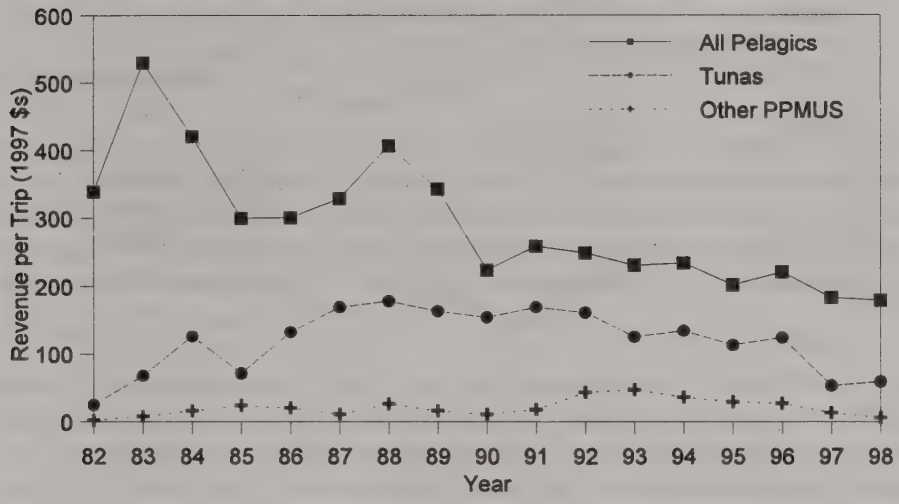
Interpretation: Prices for tuna decreased slightly in 1997 but slightly decreased this year This overall decrease since 1993 may be due to the lower price that the canneries pay per pound of tuna than the local stores and restaurants may pay. Prices in general for pelagic species remain low likely because of competition from frozen fish purchased from foreign longline vessels moored in Pago Harbor and from fishes imported from neighboring islands.

Calculation: The average price per pound for each year is calculated by dividing the estimated revenue by the estimated weight sold. The adjustment for inflation is made by multiplying the annual average price for a given year by the 1996 consumer price index (CPI) for American Samoa, and dividing by the CPI for the given year.

[data on following page]

	Average Price ($/lb)			
	Tunas		Other PPMUS	
Year	Unadjust.	Adjusted	Unadjust.	Adjusted
1982	0.86	1.36	1.01	1.60
1983	0.69	1.08	1.31	2.06
1984	0.59	0.90	1.18	1.82
1985	0.95	1.46	1.53	2.34
1986	0.81	1.21	1.37	2.03
1987	0.83	1.18	1.19	1.70
1988	0.83	1.14	1.40	1.92
1989	0.98	1.30	1.23	1.63
1990	1.15	1.40	1.13	1.38
1991	1.51	1.76	1.49	1.75
1992	1.15	1.29	1.92	2.16
1993	1.52	1.71	2.09	2.35
1994	1.36	1.49	1.62	1.78
1995	1.06	1.14	1.41	1.53
1996	1.27	1.32	1.33	1.38
1997	**1.04**	**1.05**	**1.28**	**1.30**
1998	**1.16**	**1.16**	**1.69**	**1.69**
Average	**1.04**	**1.29**	**1.42**	**1.79**

Figure 13. American Samoa average inflation-adjusted revenue per trip landing PPMUS for non-longline vessels

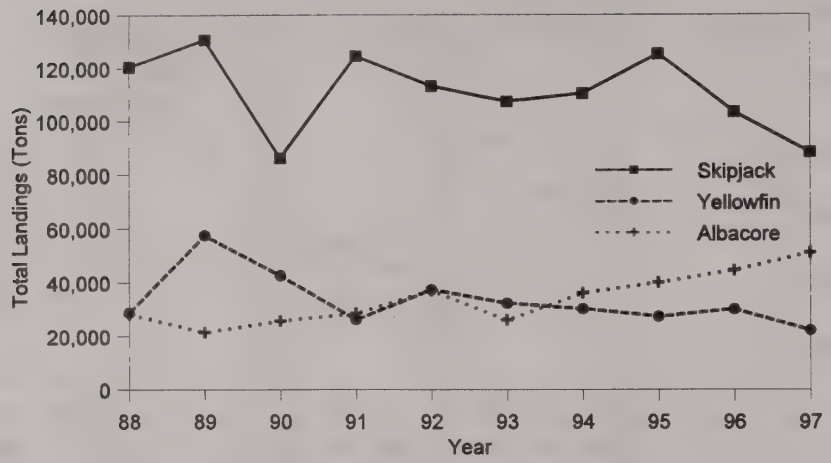


Interpretation: Revenue per trip (all pelagics) decreased in 1997 and again this year. This may be due to the overall decrease in CPUE for most species caught by trolling vessels.

Calculation: For commercial trips where pelagic species were landed, the average revenue per trip was calculated for each category. Revenue was adjusted for inflation by multiplying it by the quotient of the 1998 CPI divided by the respective years' CPI.

	Revenue per trip ($)					
	All Pelagics		Tuna		Other PPMUS	
Year	Unadjust.	Adjusted	Unadjust.	Adjusted	Unadjust.	Adjusted
1982	214	339	16	25	1	2
1983	338	530	43	68	5	8
1984	274	421	82	126	11	16
1985	196	300	47	71	16	24
1986	203	301	90	132	14	20
1987	232	329	119	169	8	11
1988	297	407	130	178	19	26
1989	260	343	124	163	12	16
1990	184	224	126	154	9	11
1991	221	259	145	169	15	18
1992	223	249	144	161	38	43
1993	206	231	111	125	42	47
1994	212	234	122	134	32	36
1995	187	202	105	113	27	29
1996	213	221	119	124	26	27
1997	**181**	**183**	**53**	**53**	**13**	**13**
1998	**179**	**179**	**59**	**59**	**6**	**6**
Average	**225**	**291**	**96**	**119**	17	21

Figure 14. Total cannery landings for skipjack, yellowfin and albacore tuna



Interpretation: The quantity of fish landed at American Samoa's canneries exceeds local landings by a factor of a thousand. Though some locally caught pelagics, especially albacore, are sold to the canneries, the vast majority of the fish landed have been taken in distant water fisheries. Cannery landings have remained essentially stable for the last several years, though albacore landings have increased across time.

Calculation: Cannery landings are from monthly landings summaries supplied by the canneries.

	Short Tons landed		
Year	**Skipjack**	**Yellowfin**	**Albacore**
1988	120,500	28,800	28,200
1989	130,800	57,500	21,400
1990	86,300	42,600	25,700
1991	124,400	26,200	28,500
1992	113,200	37,200	36,900
1993	107,400	32,200	26,000
1994	110,500	30,100	36,000
1995	125,300	27,300	40,000
1996	103,600	30,000	44,500
1997	88,400	22,700	50,900
1998	112,764	41,000	54,500
Average	**111,040**	**34,145**	**35,691**

Appendix 2

Territory of Guam

Introduction and Summary

Pelagic fishing vessels based on Guam fall into two broad categories: 1) distant-water purse seiners and longliners that fish primarily outside Guam's EEZ and transship through Guam and 2) small primarily recreational trolling boats that are either towed to boat launch sites or berthed in marinas and fish only local waters, either within Guam's EEZ or occasionally in the adjacent EEZ of the Northern Mariana Islands. This report covers primarily the local small boat pelagic fishery.

The number of boats participating in Guam's pelagic fishery steadily increased from 119 in 1980 to 482 in 1996. The number of boats decreased slightly in the past two years. Most fishing boats are less than 10 meters (33 feet) in length and are typically owner-operated by persons who earn a living outside of fishing. Most fishermen sell a portion of their catch at one time or another, and it is impossible to make a distinction between recreational, subsistence, and commercial fishers. A small, but significant, segment of the pelagic fleet consists of marina-berthed charter vessels that are operated primarily by full-time captains and crews.

Estimated pelagic annual landings have varied widely, ranging between 175 and 433 tons. Total pelagic landings in 1998 were approximately 409 tons, an increase of 10% compared with 1997. Landings in 1998 consist almost entirely of five major species: mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and Pacific blue marlin (*Makaira mazara*). Minor components include rainbow runner (*Elagatis bipinnulatus*), great barracuda (*Sphyraena barracuda*), kawakawa (*Euthynnus affinis*), sailfish (*Istiophorus platypterus*), dogtooth tuna (*Gymnosarda unicolor*), and sharks. Approximately a dozen additional species are landed incidentally each year.

There are wide year to year fluctuations in the mahimahi, wahoo, marlin, and tuna landings. Yellowfin tuna landings declined from 1982 to 1989, then show a general increase. Blue marlin began increasing in 1980, peaked in 1990, then have shown a general decrease since.

Aggregate landings of all pelagics, tuna, non-tuna PPMUS fluctuate greatly, but appear to be increasing. In the early 1980s, the pelagic catch consisted primarily of tunas. Then beginning in 1985, non-tuna PPMUS, primarily mahimahi, began making up the bulk of the pelagic catch. The commercial landings of all pelagics also show a similar trend.

The average troll trip length and trolling effort in terms of total hours fished and total trolling trips remained virtually the same compared with 1997. Charter boat activity, however, decreased for the second year in a row, due to a drop in tourism as a result of the Asian economic crisis. Charter trolling trips decreased 17% in 1997, then decreased 26% in 1998. Charter boats make

up less than 10% of the pelagic fleet, yet account for 25% of all trolling trips, 15% of the pelagic catch, and 19% of hours spent trolling. Charter boats caught 23% of the mahimahi landings and 36% of the blue marlin landings.

Trolling catch rates vary widely for all pelagic species. Trolling catch rate decreased for blue marlin and skipjack tuna, and increased for mahimahi, wahoo, and yellowfin tuna. CPUE for non-charter boats was slightly higher than for charter boats, 12.6 pounds per hour fished compared with 11.2 pounds per hour fished for charter boats.

Commercial landings and commercial revenues of all pelagics, tuna, and non-tuna PPMUS increased in 1998, especially with non-tuna PPMUS. This may have been due to improved marketing of pelagic fish by vendors and competition between major vendors the past few years for pelagic fish. Inflation-adjusted revenues per trolling trip show a general decline, although increased slightly in 1998. Since the vast majority of boaters in the pelagic fishery do not rely on catching or selling fish for a living, effort continues to occur despite decreasing revenues. The average price of tuna and non-tuna PPMUS also show a general decline, although the price of non-tuna PPMUS has increased since 1995.

1997 Recommendations and **current status**:

1. The status and ongoing usefulness of the Guam consumer price index (CPI) for time-series inflation-adjustment should be reviewed. Since the consumer price index base year has been changed, knowing how to adjust for previous years should be examined.

There has been a concern regarding the use of the Guam consumer price index for time-series inflation adjustments. Since the market basket that was set in 1978 was used until the third quarter of 1995 to determine the Guam CPI, inflation adjustments between 1988 and 1995 may not be accurate. WPacFIN estimated a historical CPI for Guam which is used for inflation-adjusted time-series in this report.

2. The Guam Offshore Expansion system is being developed with the assistance of NMFS. DAWR's historical offshore data should be incorporated into the new system to obtain a historical look at the growth and evolution of the local pelagic fishery.

DAWR is currently completing a new offshore expansion system with the assistance of NMFS. The expansion algorithms for catch and effort are currently being reviewed and revised for all strata covered by the offshore creel survey.

1998 Recommendations:

1. The Guam Offshore Expansion system is being completed with the assistance of NMFS. DAWR's historical offshore data should be incorporated into the new system to obtain a historical look at the growth and evolution of the local pelagic fishery.
2. Include a time-series of pelagic landings showing charter and non-charter categories.
3. Compare time-series of CPUE between charter and non-charter categories for select species.
4. Include the Guam CPI where time-series inflation adjustments are discussed.

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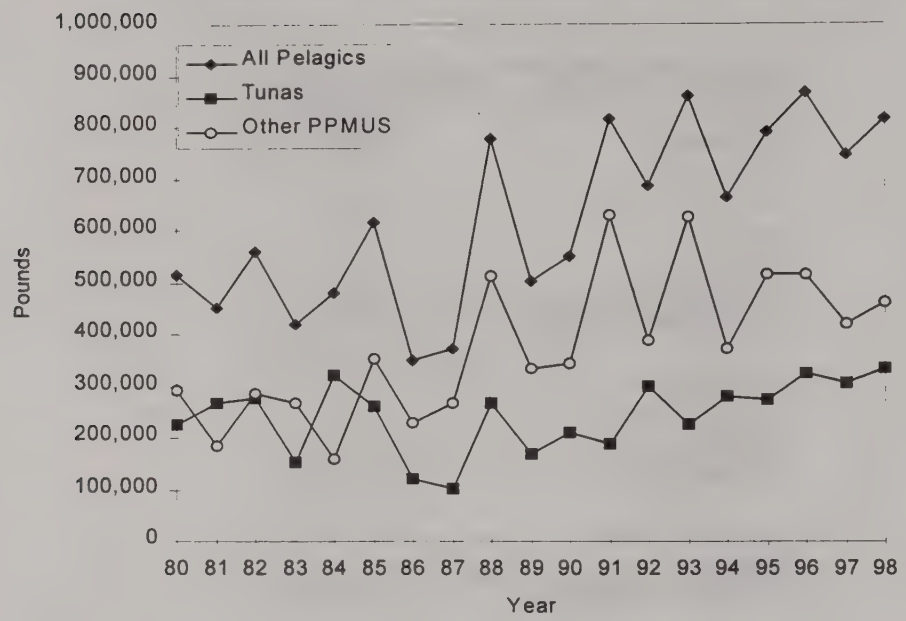
Table 1. Guam 1998 creel survey - pelagic species composition

Species	Pounds Landed
Sharks	8,017
Mahimahi	251,357
Wahoo	155,690
Blue Marlin	43,616
Striped Marlin	0
Sailfish	700
Shortbill Spearfish	894
Dogtooth Tuna	356
Double-lined Mackerel	92
Subtotal PPMUS	**460,722**
Skipjack Tuna	191,054
Yellowfin Tuna	137,881
Bigeye Tuna	0
Kawakawa	3,576
Other Tuna	0
Subtotal Tunas	**332,511**
Rainbow Runner	1,928
Barracudas	6,819
Other	580
Subtotal Misc.	**9,327**
Assorted Troll Fish	14,527
Total Pelagics	**817,087**

Table 2. Guam 1998 average commercial price of pelagic species

Species	Average Price ($/lb.)
Sharks	0.50
Mahimahi	1.84
Wahoo	2.17
Marlin	1.15
Spearfish	1.25
Sailfish	1.31
Dogtooth Tuna	1.61
Average Other PPMUS	1.84
Skipjack Tuna	1.25
Yellowfin Tuna	2.16
Kawakawa	1.27
Average Tuna	1.68
Rainbow Runner	2.27
Barracuda	1.97
Average All Pelagics	1.80

Figure 1. Guam annual estimated total landings: all pelagics, tunas, and other PPMUS



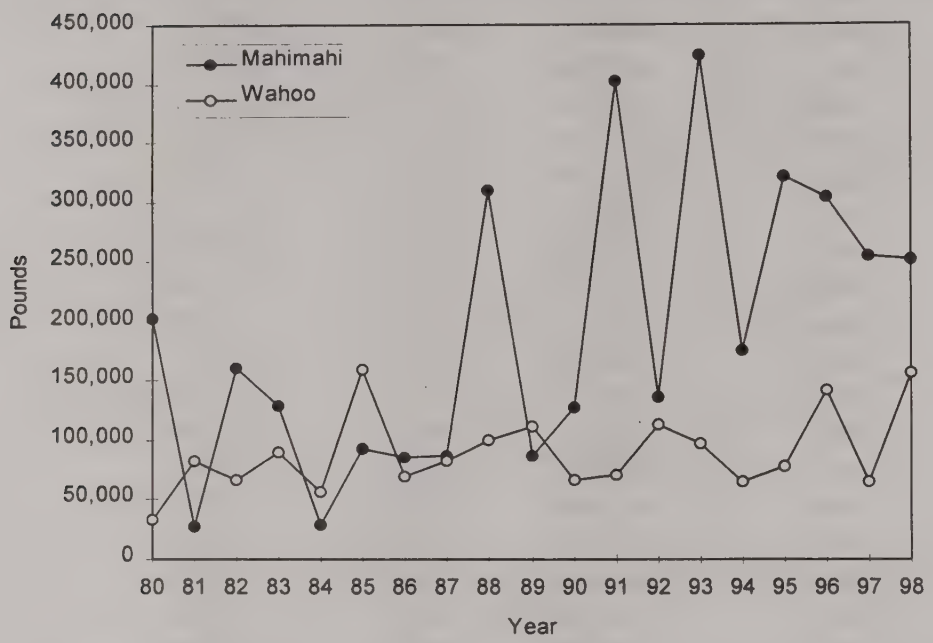
Interpretation: In the early 1980's, the bulk of the pelagic catch consisted primarily of tunas. Beginning in 1985, non-tuna PPMUS began making up the bulk of the pelagic catch due to an interest in targeting blue marlin, an increase in mahimahi landings, and a lack of interest in skipjack tuna. In 1998, total pelagic landings increased 10%, tuna landings increased 9%, and non-tuna PPMUS increased 9%. Charter trolling trips account for 15% of the overall pelagic catch.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program, expanded with the assistance of NMFS.

Calculation: A 362 day (363 days during leap years) expansion is run for each calendar year of survey data to produce catch and effort estimates for each fishing method surveyed. Percent species composition is calculated by weight for the sampled catch for each method to produce catch estimates for each species for the expanded period. The annual catch for all pelagic species and the PPMUS separately are summed across all methods to obtain the numbers plotted above except for 1992 which includes only the trolling method.

Year	Pounds Landed		
	All Pelagics	Tunas	Other PMUS
1980	515,631	224,928	290,703
1981	450,813	267,264	183,549
1982	560,046	275,851	284,195
1983	418,222	151,106	267,117
1984	479,134	157,991	321,143
1985	614,520	261,872	352,649
1986	347,673	120,543	227,130
1987	370,586	102,519	268,068
1988	776,336	265,785	510,551
1989	501,880	167,024	334,857
1990	549,944	208,159	341,785
1991	814,786	187,388	627,398
1992	685,513	296,833	388,634
1993	858,944	224,656	626,907
1994	663,476	279,657	372,541
1995	791,176	271,505	514,391
1996	865,967	322,657	512,925
1997	740,077	304,992	417,744
1998	**817,087**	**332,511**	**460,722**
Average	**622,464**	**375,782**	**241,389**
Standard Deviation	**171,393**	**137,557**	**69,030**

Figure 2. Guam annual estimated total landings: mahimahi and wahoo



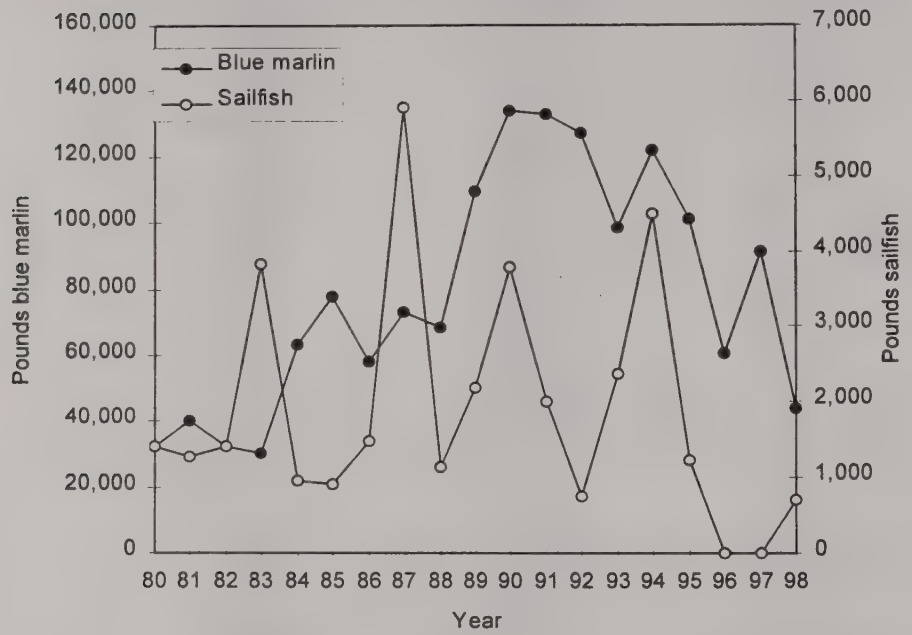
Interpretations: Wahoo landings increased 139% in 1998, while mahimahi landings decreased slightly. Mahimahi still remained the most important pelagic species in Guam's small boat fishery. Both species still show a pattern of long-term extreme fluctuations, especially mahimahi. Charter boats account for 23% of the mahimahi landings and 9% of the wahoo landings. Virtually all landings were done by the trolling method.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files, expanded with the assistance of NMFS.

Calculation: Totals by species are summed across all fishing methods for all years except 1992-93 as described in Figure 1.

Year	Pounds Landed Mahimahi	Wahoo
1980	203,136	32,825
1981	27,954	82,635
1982	160,200	66,416
1983	128,130	89,010
1984	28,847	56,501
1985	92,407	159,300
1986	85,393	68,830
1987	86,362	82,892
1988	310,032	99,801
1989	87,158	111,977
1990	126,968	66,107
1991	402,107	71,001
1992	136,421	112,872
1993	423,988	97,448
1994	175,183	64,595
1995	321,014	78,530
1996	303,957	142,062
1997	254,013	65,036
1998	**251,357**	**155,690**
Average	**189,717**	**89,659**
Standard Deviation	**119,751**	**34,007**

Figure 3. Guam annual estimated total landings: blue marlin and sailfish



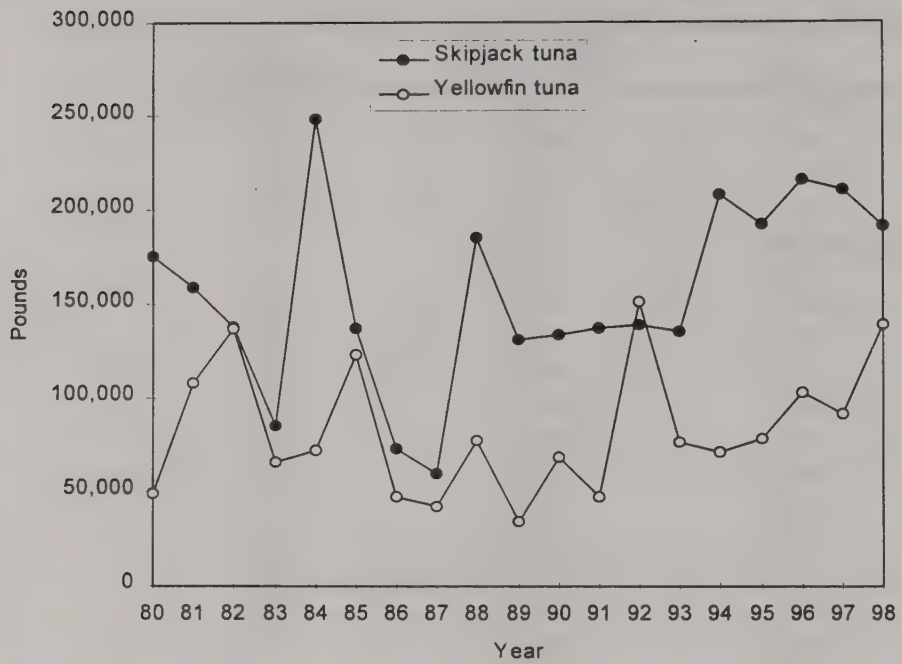
Interpretations: Blue marlin landings decreased 52% in 1998. Sailfish, which were not encountered during offshore creel surveys in 1996 and 1997, had an estimated landing of 700 pounds. The rapid increase in marlin landings beginning in 1988 may have been due to an increase in charter boat activity and targeting of this species by charter boats during the marlin season. Since 1991, annual marlin landings have generally decreased. All landings of blue marlin were by the trolling method, with charter boats accounting for 36% of total marlin landings. A 26% decrease in charter boat trips during 1998 probably contributed to the decrease in blue marlin landings.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files, expanded with the assistance of NMFS.

Calculation: Totals by species are summed across all fishing methods for all years except 1992-93 as described in Figure 1.

Year	Pounds Landed Blue Marlin	Sailfish
1980	32,192	1,411
1981	40,389	1,272
1982	32,465	1,425
1983	30,359	3,820
1984	63,057	952
1985	77,565	915
1986	57,682	1,474
1987	73,169	5,913
1988	68,511	1,145
1989	109,241	2,191
1990	136,541	3,730
1991	129,992	2,000
1992	127,356	745
1993	98,698	2,379
1994	121,844	4,482
1995	101,359	1,242
1996	60,500	0
1997	90,979	0
1998	**43,616**	**700**
Average	**78, 748**	**1,887**
Standard Deviation	**35,549**	**1,568**

Figure 4. Guam annual estimated total landings: skipjack and yellowfin tunas



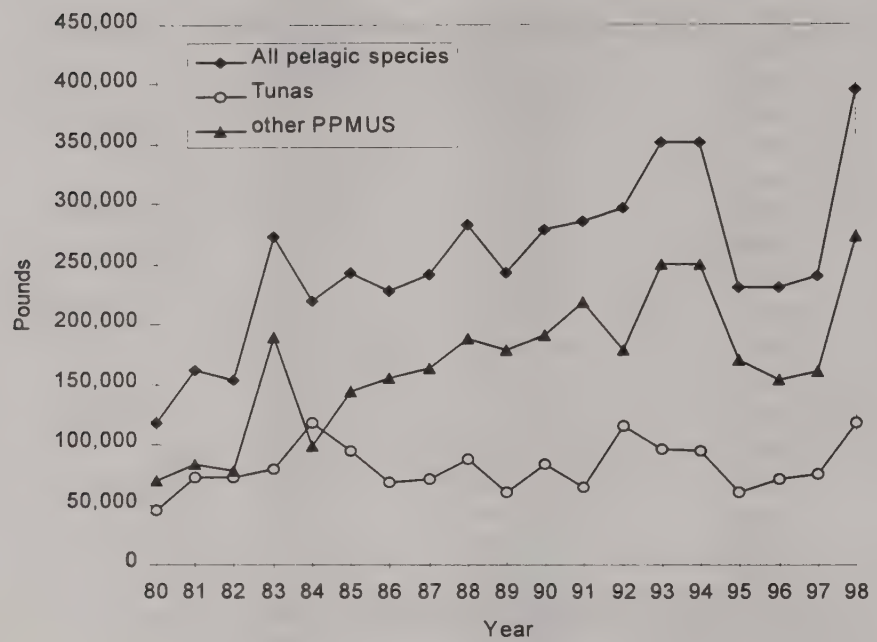
Interpretations: In 1998, skipjack tuna landings decreased 9%, while yellowfin tuna landings increased 52%. For most years, landings of skipjack tuna exceeded those of yellowfin tuna by a 2:1 margin. Given the relative unmarketability of skipjack tuna in the local market and the desirability of yellowfin tuna, the availability of skipjack tuna probably exceeds that of yellowfin by a wider margin. Non-charter boats account for 86% of the skipjack landings and 96% of the yellowfin landings.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files, expanded with the assistance of NMFS.

Calculation: Totals by species are summed across all fishing methods for all years except 1992-93 as described in Figure 1.

Year	Pounds Landed	
	Skipjack tuna	Yellowfin tuna
1980	175,542	49,386
1981	158,493	107,828
1982	137,735	137,202
1983	85,008	65,598
1984	248,243	71,502
1985	137,097	122,707
1986	73,199	47,290
1987	59,228	41,754
1988	184,838	77,434
1989	130,682	34,404
1990	133,460	68,076
1991	137,136	47,398
1992	138,547	151,025
1993	135,163	76,285
1994	207,713	70,902
1995	192,218	78,021
1996	215,944	102,670
1997	210,919	90,798
1998	**191,054**	**138,351**
Average	**155,380**	**83,086**
Standard Deviation	**50,410**	**34,889**

Figure 5. Guam annual estimated commercial landings: all pelagics, tunas, and other PPMUS



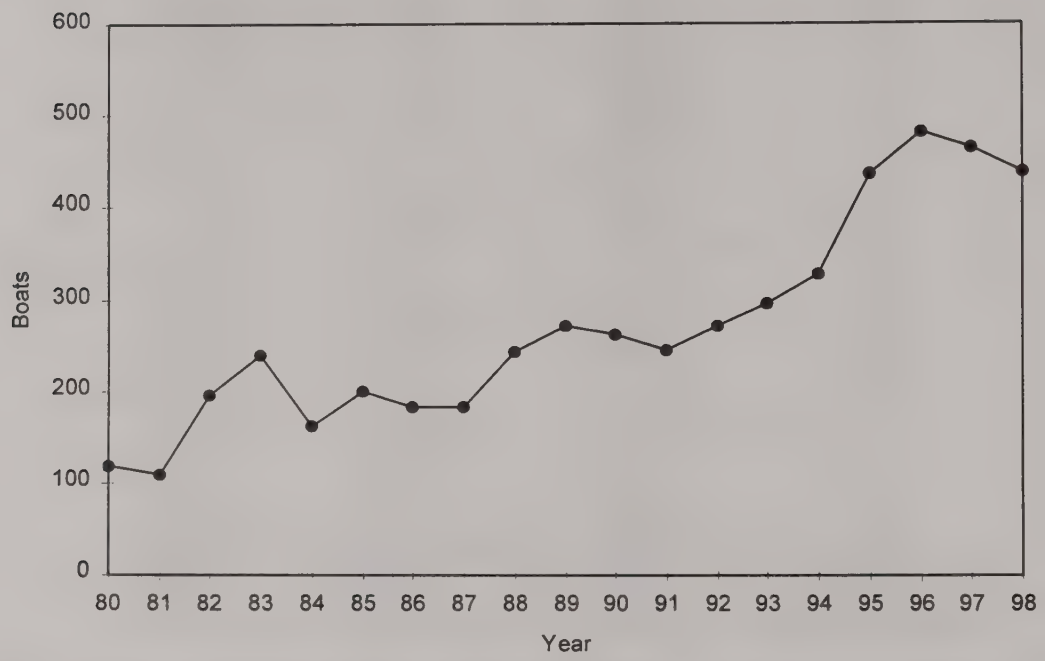
Interpretations: Commercial pelagic fishery landings appear to have increased steadily for the last 18 years, especially with the growth of the charter boat industry. A drop in landings between 1995 and 1996 may have been due primarily to a major fish vendor going out of business and fishermen marketing their fish to vendors that were not part of the commercial receipt book program. In 1998, commercial landings increased 65% for all pelagics, increased 56% for tunas, and increased 71% for non-tuna PPMUS. The increase in commercial landings may be due partly to major vendors competing for pelagic fish and better marketing by these vendors.

Source: The WPacFIN-sponsored commercial landings system.

Calculation: The total estimated commercial landings for each year were calculated by summing the weight fields in the commercial landings data base from the principle fish wholesalers on Guam, and then multiplying by an estimated percent coverage expansion factor. The annual expansion factor was subjectively created based on as much information as possible depending on the year, including: an analysis of the "disposition of catch" data available from the DAWR offshore creel survey; an evaluation of the fishermen in the fishery and their entry/exit patterns; general "dock side" knowledge of the fishery and the status of the marketing conditions and structure; the overall number of records in the data base; and a certain measure of best guesses.

Year	Pounds Landed		
	All Pelagic Species	Tunas	Other PPMUS
1980	118,275	45,043	70,319
1981	162,186	72,229	84,371
1982	153,577	72,347	77,602
1983	273,120	79,313	189,241
1984	220,074	118,167	98,412
1985	243,060	94,691	143,509
1986	227,928	68,510	154,749
1987	240,790	71,711	163,449
1988	283,264	87,962	188,498
1989	242,554	59,825	178,424
1990	279,121	84,176	190,201
1991	285,696	64,694	218,588
1992	296,809	114,765	178,307
1993	351,201	96,289	250,211
1994	351,187	95,321	250,348
1995	230,585	60,403	170,182
1996	229,908	71,528	154,184
1997	240,365	75,060	160,096
1998	**395,473**	**117,330**	**273,445**
Average	**265,784**	**84,833**	**176,446**
Standard Deviation	**74,950**	**20,172**	**63,569**

Figure 6. Guam estimated number of trolling boats



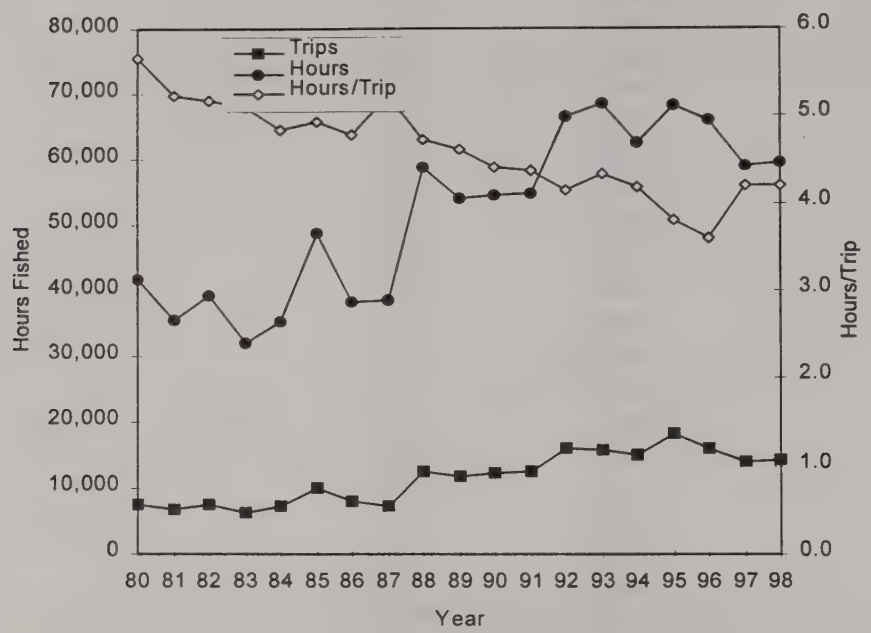
Interpretations: The number of trolling boats on Guam has been steadily increasing, especially since the addition of two marinas to the offshore sampling program. There appears to be a general increase in the number of small boats participating in Guam's pelagic fishery, while the number of charter vessels has remained fairly constant for several years. The number of trolling boats decreased slightly in 1998, approximately 6%.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files, expanded with the assistance of NMFS.

Calculation: Since only a fraction of the days of the year are sampled, it is not possible to know the exact number of boats participating in the fishery. The 1998 trolling boat log was converted and processed through a boat estimator model 1,000 times. There were 1,315 logged trolling trips made by 383 different vessels, counted on 91 sample days.

Year	Number of Boats
1980	119
1981	109
1982	196
1983	238
1984	161
1985	199
1986	182
1987	183
1988	243
1989	270
1990	262
1991	245
1992	271
1993	296
1994	328
1995	436
1996	482
1997	464
1998	**438**
Average	**270**
Standard Deviation	**113**

Figure 7. Guam annual estimated number of pelagic trips, total hours fished, and average trip length



Interpretations: Trolling effort in 1998 remained virtually the same compared with 1997. The number of trolling trips and hours spent fishing increased slightly, while trolling trip length remained the same.

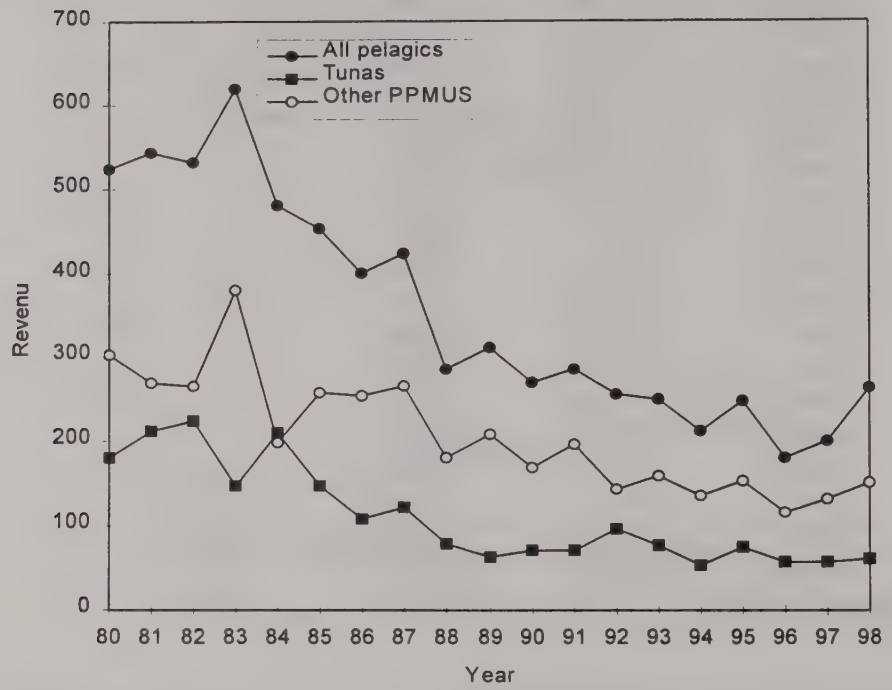
Charter boat activity decreased the past two years, due primarily to a significant drop in the number of tourists as a result of the Asian economic crisis. Compared with 1997, charter trolling trips decreased 26% while non-charter trips increased 15%. Charter trolling trips made up 25% of all trolling trips and 19% of hours spent trolling. The average trolling trip was 3.2 hours for charter boats, and 4.5 hours for non-charter boats.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: The data expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method surveyed. These plots are of the estimated boat hours spent fishing and number of trips for the trolling method as taken directly from creel survey expansion system printouts.

Year	Trips	Hours	Hours per Trip
1980	7,394	41,870	5.7
1981	6,763	35,430	5.2
1982	7,566	39,146	5.2
1983	6,287	32,085	5.1
1984	7,276	35,196	4.8
1985	9,900	48,823	4.9
1986	7,992	38,201	4.8
1987	7,342	38,475	5.2
1988	12,454	58,874	4.7
1989	11,725	54,119	4.6
1990	12,340	54,486	4.4
1991	12,523	54,686	4.4
1992	16,076	66,535	4.1
1993	15,810	68,609	4.3
1994	15,003	62,616	4.2
1995	18,214	68,285	3.8
1996	15,936	65,952	3.6
1997	14,141	59,464	4.2
1998	**14,324**	**59,583**	**4.2**
Average	**11,373**	**51,237**	**4.6**
Standard Deviation	**3,893**	**12,757**	**0.5**

Figure 8. Guam annual estimated commercial inflation-adjusted total revenues: all pelagics, tunas, and other PPMUS



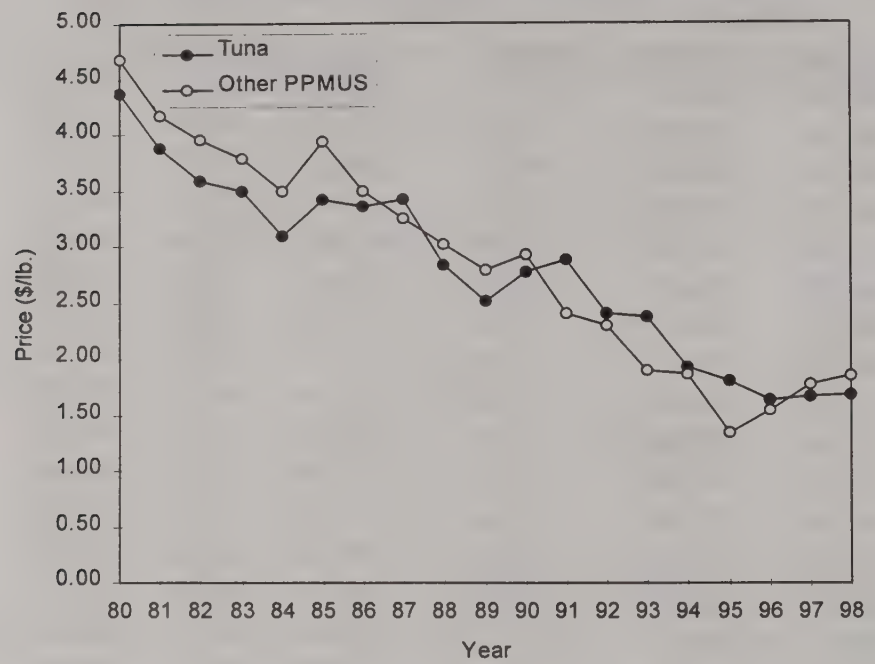
Interpretations: Adjusted revenues in 1998 increased for all pelagics, tunas, and other PPMUS. Revenues increased 37% for all pelagics, 27% for tunas, and 43% for other PPMUS. The increase in revenue mirrors the increase observed in commercial landings. The increase in revenue may be due to better marketing by fish vendors, competition for pelagic fish between major fish vendors, and an increased demand for fish.

Source: The WPACFIN-sponsored commercial landings system.

Calculation: The total estimated revenue for each year was calculated by summing the revenue fields in the commercial landings data base from the principle fish wholesalers on Guam, and then multiplying by the same percent coverage expansion factor as were the landings in figure 5. Inflation-adjusted total revenue per trip is derived from the Guam annual Consumer Price Index (CPI).

	Revenues ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	149,160	540,257	54,353	196,865	90,623	328,236
1981	218,384	656,682	92,914	279,394	117,052	351,976
1982	203,847	583,003	90,719	259,456	107,573	307,659
1983	364,527	1,007,553	100,029	276,481	258,501	714,496
1984	283,724	721,226	143,598	365,026	135,498	344,436
1985	369,651	904,536	131,953	322,890	230,855	564,903
1986	330,302	786,779	96,395	229,613	226,935	540,558
1987	347,753	793,573	107,055	244,299	233,116	531,970
1988	386,468	837,863	114,981	249,279	261,901	567,801
1989	337,586	659,980	76,865	150,272	253,932	496,437
1990	471,241	806,765	136,321	233,381	325,372	557,037
1991	462,191	717,782	119,640	185,801	337,328	523,870
1992	492,707	694,717	195,547	275,721	289,129	407,671
1993	547,835	712,734	175,360	228,144	362,728	471,909
1994	593,838	660,942	165,296	183,974	418,612	465,915
1995	537,889	568,549	173,629	183,526	361,363	381,960
1996	366,280	368,844	116,130	119,716	239,901	241,580
1997	515,007	518,097	154,819	155,748	351,229	353,337
1998	**711,066**	**711,066**	**197,677**	**197,677**	**503,600**	**503,600**
Average		**697,418**		**228,277**		**455,545**
Std Deviation		**146,877**		**61,174**		**117,637**

Figure 9. Guam average price of tunas and other PPMUS



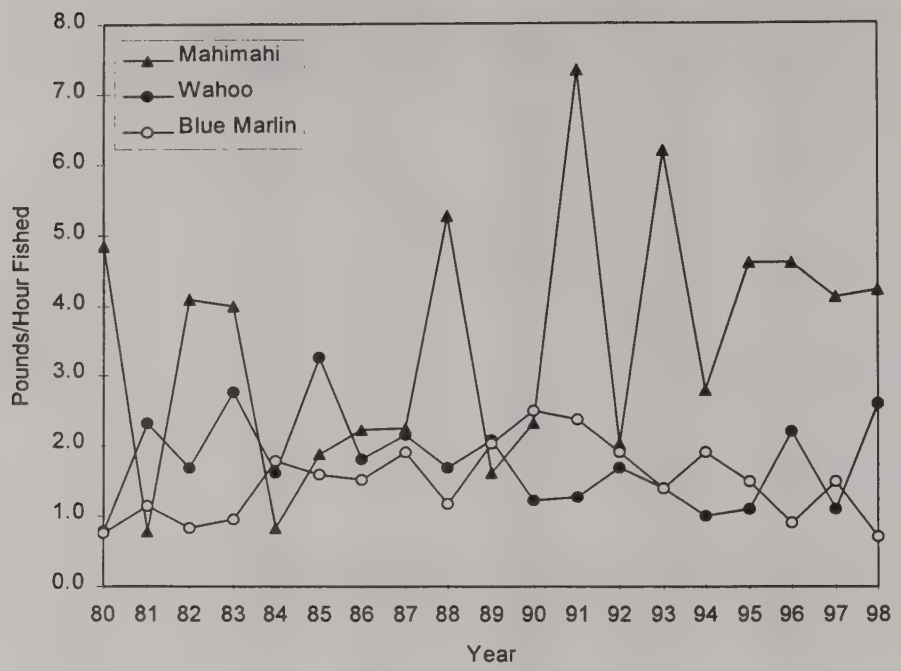
Interpretations: The inflation-adjusted price of tunas and other PPMUS shows a general decline during the past 18 years, although the adjusted price of PPMUS has shown an increase the past three years. Compared with 1997, the adjusted price for tuna and other PPMUS increased slightly, 1% and 4% respectively. The increase in price despite an increase in landings may be due to better marketing and an increased demand for pelagic fish.

Source: The WPACFIN-sponsored commercial landings system.

Calculation: The average price of the Tunas and other PPMUS groups are calculated by dividing the total revenue for each by the sold weight. The inflation adjustment is made by using the Consumer Price Index (CPI) for Guam and establishing the current year figure as the base from which to calculate expansion factors for all previous years (e.g., divide the current year CPI by the CPI of any given year), and then multiplying that factor by the unadjusted average price for the given year.

	Price ($/lb.)			
	Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	1.21	4.37	1.29	4.67
1981	1.29	3.87	1.39	4.17
1982	1.25	3.59	1.39	3.96
1983	1.26	3.49	1.37	3.78
1984	1.22	3.09	1.38	3.50
1985	1.39	3.41	1.61	3.94
1986	1.41	3.35	1.47	3.49
1987	1.49	3.41	1.43	3.25
1988	1.31	2.83	1.39	3.01
1989	1.28	2.51	1.42	2.78
1990	1.62	2.77	1.71	2.93
1991	1.85	2.87	1.54	2.40
1992	1.70	2.40	1.62	2.29
1993	1.82	2.37	1.45	1.89
1994	1.73	1.93	1.67	1.86
1995	1.70	1.80	1.27	1.34
1996	1.62	1.63	1.53	1.54
1997	1.65	1.66	1.76	1.77
1998	**1.68**	**1.68**	**1.84**	**1.84**
Average		**2.79**		**2.86**
Standard Deviation		**0.81**		**1.00**

Figure 10. Guam trolling catch rates: mahimahi, wahoo, and blue marlin



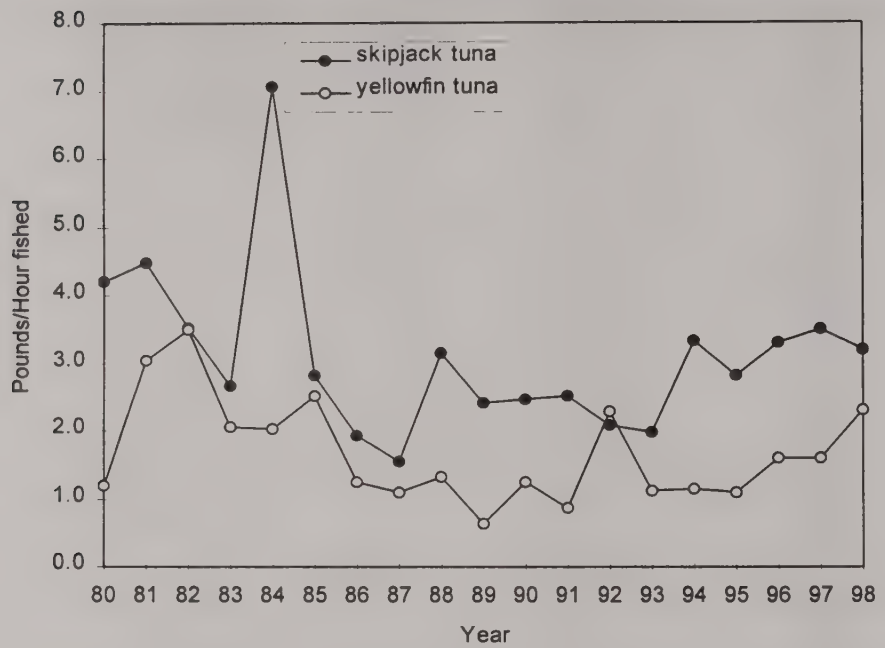
Interpretations: The wide fluctuations in CPUE are probably due to the high variability in the year to year abundance and availability of the stocks. However, since it is not possible to allocate species-specific effort, effort used to target other species can also result in artificially high or low catch rates for a given species. In 1998, the catch rate for mahimahi increased slightly (2%), increased 136% for wahoo, and decreased 53% for blue marlin. No general trend in CPUE is apparent.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: The data expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method. This plot and table of catch per unit of effort (CPUE) are based on the total annual landings of mahimahi, wahoo, and blue marlin, each divided by the total number of hours spent fishing (gear in use).

Pounds Per Hour Fished			
Year	Mahimahi	Wahoo	Blue Marlin
1980	4.9	0.8	0.8
1981	0.8	2.3	1.1
1982	4.1	1.7	0.8
1983	4.0	2.8	0.9
1984	0.8	1.6	1.8
1985	1.9	3.3	1.6
1986	2.2	1.8	1.5
1987	2.2	2.2	1.9
1988	5.3	1.7	1.2
1989	1.6	2.1	2.0
1990	2.3	1.2	2.5
1991	7.3	1.3	2.4
1992	2.0	1.7	1.9
1993	6.2	1.4	1.4
1994	2.8	1.0	1.9
1995	4.7	1.2	1.5
1996	4.6	2.2	0.9
1997	4.1	1.1	1.5
1998	**4.2**	**2.6**	**0.7**
Average	**3.5**	**1.8**	**1.5**
Standard Deviation	**1.8**	**0.7**	**0.5**

Figure 11. Guam trolling catch rates: skipjack and yellowfin tunas



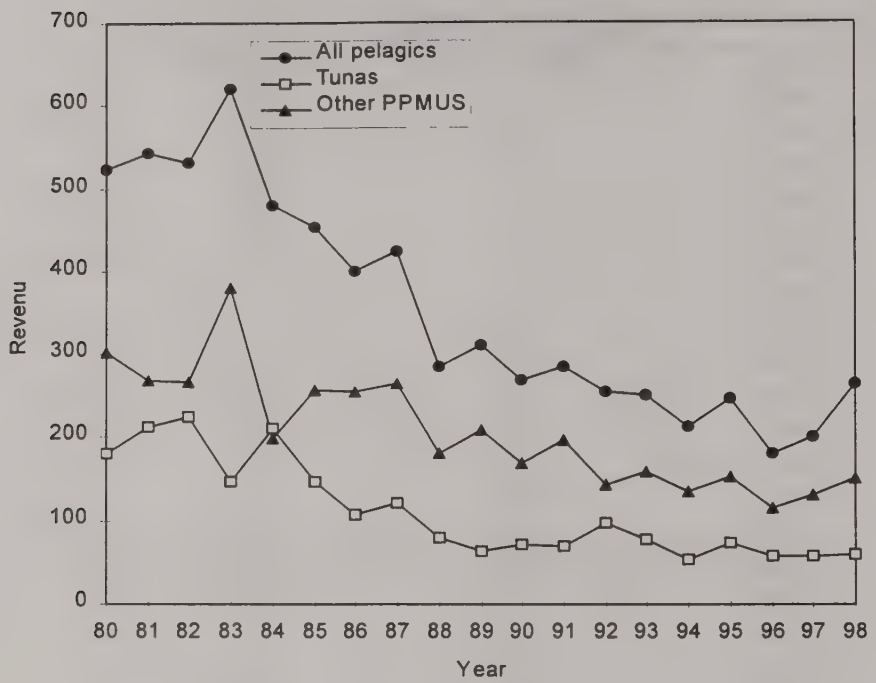
Interpretations: The wide fluctuations in CPUE for skipjack and yellowfin tunas are probably due to the high variability in the year to year abundance and availability of the stocks. Since it is not possible to allocate species-specific effort, effort used to target other species can also result in an artificially high or low catch rate for a given species. Compared with 1997, the catch rate for yellowfin tuna increased 30%, while the catch rate of skipjack tuna decreased 9%.

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files, expanded with the assistance of NMFS.

Calculation: The data expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method surveyed. This plot and table were calculated the same way as Figure 10.

Pounds Per Hour Fished		
Year	Skipjack Tuna	Yellowfin Tuna
1980	4.2	1.2
1981	4.5	3.0
1982	3.5	3.5
1983	2.6	2.0
1984	7.1	2.0
1985	2.8	2.5
1986	1.9	1.2
1987	1.5	1.1
1988	3.1	1.3
1989	2.4	0.6
1990	2.5	1.2
1991	2.4	0.9
1992	2.1	2.3
1993	2.0	1.1
1994	3.3	1.1
1995	2.8	1.1
1996	3.3	1.6
1997	3.5	1.6
1998	**3.2**	**2.3**
Average	**3.1**	**1.7**
Standard Deviation	**1.2**	**0.8**

Figure 12: Guam inflation-adjusted revenues per trolling trip: all pelagics, tunas, and other PPMUS



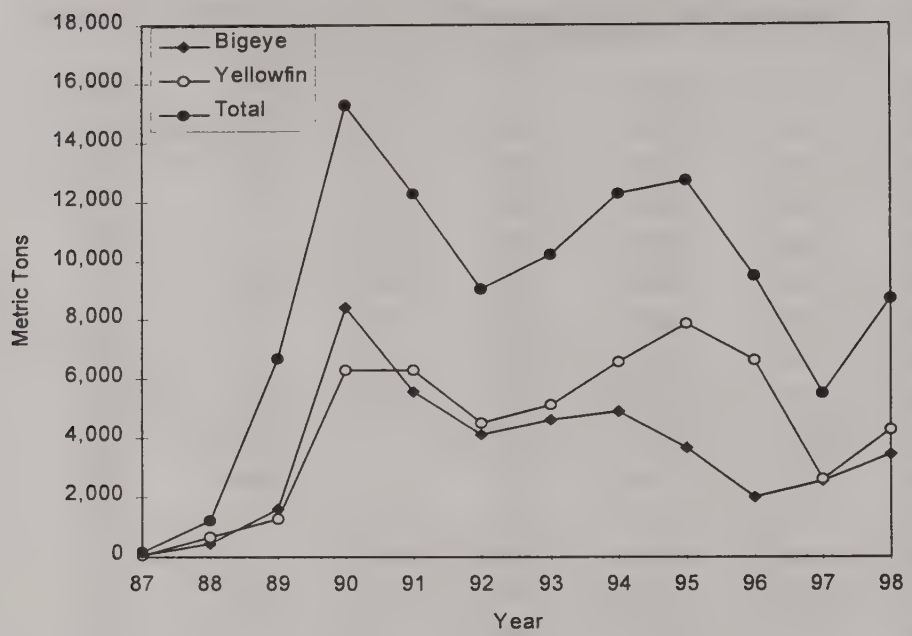
Interpretation: The adjusted revenue per trip for all pelagics, tunas, and other PPMUS increased in 1998. Adjusted revenue per trip increased 32% for all pelagics, increased slightly (3%) for tunas, and increased 16% for other PPMUS. Care must be taken in interpreting this data, since the Guam fishery is subject to biases created by marketing problems and the market structure upon which the data collecting system is based. During 1988, 1991, and 1993, record highs in the abundance and landings of mahimahi did not result in high revenues per trolling trip for those years. A glut in the market and other marketing problems during those years resulted in low revenues per trolling trip. Beginning in 1997, though, several major fish vendors began competing for pelagic fish, with one placing no limit on fish sold to it by its members. Despite revenues increasing or decreasing, effort still occurs since most charter and non-charter trolling boats do not rely on selling their fish for a living.

Source: The WPacFIN-sponsored commercial landings system.

Calculation: The average revenue per trip was calculated by summing the revenue of all species sold then dividing by the number of trips, and summing the revenue of tunas and other PPMUS sold, and then dividing each by the number of trips, respectively, for any trip which landed PPMUS. Adjusted revenue per trip was derived from the Guam Annual Consumer Price Index (CPI).

	Revenues per trip ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	144	523	50	181	84	302
1981	181	543	71	213	89	269
1982	186	531	78	224	93	266
1983	224	620	53	147	137	380
1984	189	480	83	210	78	199
1985	185	453	60	147	105	257
1986	168	400	45	108	107	254
1987	185	423	53	122	116	265
1988	132	285	37	79	83	181
1989	159	311	32	63	107	208
1990	157	269	42	71	99	170
1991	183	285	45	70	127	197
1992	181	255	69	97	102	143
1993	192	250	59	77	122	159
1994	192	213	48	53	121	135
1995	234	247	70	74	146	154
1996	179	180	57	57	115	116
1997	199	200	58	58	131	131
1998	**264**	**264**	**60**	**60**	**152**	**152**
Average		**354**		**111**		**207**
Standard Deviation		**136**		**59**		**70**

Figure 13. Annual Guam longline landings from foreign longliners fishing outside the Guam EEZ



Interpretation: Annual landings from a primarily foreign longline fishing fleet have ranged up to 15,278 tons since the fishery began in the late 1980's. These vessels fish primarily outside Guam's EEZ, yet transhipment their catch from Guam. In 1998, the majority of longline vessel port calls were made by Taiwanese (56%) and Japanese (40%) longline vessels. A total of 183 vessels made 845 port calls, a 23% decrease in the number of port calls compared with 1997. The landings were 49% yellowfin tuna, 39% bigeye tuna, 7% of various marlin species, and 5% of all other species combined. Compared with 1997, total longline landings increased 58%, bigeye landings increased 33%, and yellowfin tuna landings increased 65%. The increase in 1998 longline landings could reflect a reversal of climatic changes that occurred during 1997 which negatively affected migrating pelagic fish stocks to the region.

Source: The Guam Department of Commerce.

Calculation: Pre-1990 data was extracted directly from transshipment agents' files. Beginning in 1990, a mandatory data submission program was implemented.

Year	Total (tons)	Bigeye tuna (tons)	Yellowfin tuna (tons)
1987	144	60	72
1988	1,236	462	682
1989	6,691	1,615	1,274
1990	15,278	8,433	6,283
1991	12,264	5,549	6,279
1992	9,017	4,150	4,537
1993	10,207	4,630	5,126
1994	12,283	4,896	6,553
1995	12,733	3,658	7,872
1996	9,460	2,014	6,653
1997	5,503	2,587	2,600
1998	**8,686**	**3,430**	**4,289**
Average	**8,625**	**3,457**	**4,352**
Standard Deviation	**4,584**	**2,332**	**2,610**

Appendix 3

Hawaii

Introduction and Summary

Hawaii's commercial pelagic catch[1] remained at essentially the same level in 1998 as in 1997 following a large increase from 1996. Longline catch increased marginally (6 %) reaching record levels in 1998. Handline and troll catch of pelagics declined 11% although this variation is typical for these gear types. However their combined catch has declined 30% since their 1994 peak.

Effort in the longline fishery in 1998 was directed toward tunas rather than swordfish (with resultant changes in catch composition). The number of active longliners declined from 1991 to 1996 as a number of vessels left Hawaii for U.S. mainland fisheries. In the latter part of 1997, 15 longline vessels migrated to California and fished mainly swordfish for the remainder of the year. However, in 1998, the number of longline vessels off-loading in Hawaii increased as vessels from California and the East coast again based themselves out of Honolulu. Thus, longline activity was at its highest point in 1998 since 1994. Tuna prices were down in 1998, as were swordfish prices, reflecting rather different market conditions.

Probably the most significant change over the past several years has been the shift of longline effort out of swordfish into tuna. The number of swordfish-directed trips has declined from 319 in 1993 to just 84 trips in 1998. Meanwhile tuna-directed trips have increased from 542 to 760 trips over the same period.

Finally, albacore catch by longline, handline, and other gear types increased by 460% from 1992 to 1997, but 1998 saw a 25 % reduction of catch (all gears combined) compared to 1997.

A number of fishery management issues were significant in 1998. Shark finning by longline and other vessels is one issue which led to State of Hawaii legislative hearings early in 1999. Protected species interactions (marine turtles and sea birds) in the longline fishery continue to be of concern. Considerable research effort is being directed toward the interactions problem by National Marine Fisheries Service (NMFS) and the Council. Finally, issues have been raised concerning the use of blue marlin as a commercial landing by both the longline fishery as well as in the charter fishery. Some of the JIMAR economic research projects will provide information on the relative values of blue marlin to the various fisheries sectors in Hawaii, but other questions continue concerning fishery interactions.

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[1] This module reports "catch", as opposed to "landings" in most cases. Catch is that identified as *Pounds Caught* on HDAR commercial catch reports or the volume estimated from the longline logbook's number caught (x estimated round weight of fish kept). In some cases *Pounds Sold* are used in a market sense (i.e., number kept x estimated round weight).

Information & Sources

This report contains the most recently available information on Hawaii's commercial pelagic fishery. Commercial fisheries data are compiled from two sources: The State of Hawaii's Division of Aquatic Resources (HDAR) commercial catch reports, and the U.S. National Marine Fisheries Service (NMFS) Honolulu Laboratory longline logbooks and marketing monitoring samples.[2] Data on the recreational fishery are not available since recreational fishers are not required to file catch reports (if they sell no fish during the year) and there is no comprehensive creel survey of Hawaii anglers. A recent JIMAR research report gives some idea of the relationship between commercial and recreational pelagic fishing, but estimates of total recreational participation and catch remain absent.[3]

The module was prepared using preliminary 1998 NMFS and HDAR data. NMFS longline data for 1991-97 were updated and can be considered "final", and the 1998 longline data are essentially complete. HDAR commercial catch reports for 1998, which comprise the troll, handline, pole-and-line, and other gears data, were made available in unedited format so changes can be expected. "Final" NMFS and HDAR figures for 1998 will appear in the annual report for 1999.

Total landings in the troll, handline and other CPUE analyses do not necessarily equal overall landings tables by gear type due to separate compilations based on separate versions of the HDAR data sets.

This module was prepared by Sam Pooley, NMFS and Walter Ikehara, HDAR. Information on longline catch and logbooks was provided by Russell Ito and Frederick Dowdell, NMFS. Information on HDAR Commercial Marine Licenses was provided by Reginald Kokubun, HDAR. HDAR commercial catch data was compiled by Frank Cabacungan, NMFS.

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2 Ito, Russell Y. and Machado, Walter A. 1997. Annual report of the Hawaii-based longline fishery for 1996. Southwest Fisheries Science Center administrative report H-97-12.

3 Hamilton, Marcia S and Huffman, Stephen W. 1997. Cost-earnings study of Hawaii's small boat fishery, 1995-96. University of Hawaii SOEST 97-06/JIMAR 97-314. 102 p.

Hawaii commercial marine license information[4]

Every fisherman, including crew members on commercial fishing vessels, who takes any marine species for commercial purposes is required by the State to have a Commercial Marine License (CML) and, unless specifically exempted[5], is required to submit a catch report monthly to HDAR.

A total of 3,657 fishermen were licensed by the State of Hawaii in calendar year 1998, of which 2,754 were required to file monthly catch reports. As of April 1999, HDAR had received 29,242 monthly reports (84 % of the 34,690 monthly reports expected based on the number of license holders and the number of months in 1998 in which they held their licenses).

HDAR asks fishermen to identify their primary fishing gear or method on the Commercial Marine License at time of licensing. This does not preclude fishermen from using other gears or methods, but it indicates what they consider to be their primary fishing method.

Primary fishing method	**Number of licenses required to report**	
	1997	**1998**
Trolling	1,589	1,574
Longline	474	446
Ika shibi & palu ahi	170	180
Baitboat	45	75
Total pelagic	2,278	2,275
Total all methods	3,658	3,657

[4] Information provided by the Hawaii Division of Aquatic Resources (HDAR).

[5] Only one person per vessel or fishing trip is required to submit a catch report. This person is usually, but not always, the captain. (The captain may or may not be the vessel owner.) Crew members are generally not required to submit catch reports.

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Table 1. Hawaii domestic commercial catch, revenue and prices[6], 1997-98.

Species	1997 Pounds Caught (x 1,000)	1997 Ex-vessel Revenue (x $1,000)	1997 Average Price ($/lb)	1998 Pounds Caught (x 1,000)	1998 Ex-vessel Revenue (x $1,000)	1998 Average Price ($/lb)
Swordfish	6,400	14,100	2.21	7,200	12,000	1.67
Blue marlin	1,900	1,500	0.82	1,300	1,500	1.15
Striped marlin	900	1,100	1.25	900	1,000	1.11
Other billfish	400	300	0.95	400	300	0.75
Mahimahi	1,100	1,800	1.65	800	1,600	2.00
Ono (wahoo)	800	1,400	1.79	700	1,400	2.00
Opah (moonfish)	800	900	1.14	900	1,000	1.11
Sharks[7]	5,000	2,000	0.40	6,300	1,500	0.24
Other pelagics	200	300	1.47	300	400	1.10
Non-Tuna PMUS Subtotal	**17,500**	**23,400**	**1.35**	**18,800**	**20,700**	**1.10**
Albacore	4,000	4,800	1.21	3,000	3,600	1.19
Bigeye tuna	5,600	17,700	3.16	7,400	21,500	2.89
Bluefin tuna	50	800	15.48	40	250	7.03
Skipjack tuna	2,600	3,100	1.18	1,200	1,400	1.19
Yellowfin tuna	4,600	11,100	2.41	3,400	7,400	2.16
Tuna PMUS Subtotal	**16,850**	**37,500**	**2.23**	**15,040**	**34,150**	**2.26**
TOTAL	**34,350**	**60,900**	**1.78**	**33,840**	**54,850**	**1.62**

Interpretation: Total pelagic catch decreased 1% by while revenue decreased by 10%. Ex-vessel prices were lower in general. Swordfish and bigeye tuna continue to dominate pelagic catch in Hawaii. Swordfish catch increased substantially in 1998 even though the number of swordfish-directed longline trips declined. Swordfish prices declined in 1998.

Bigeye catch also increased substantially, as tuna-directed longline trips increased. As with swordfish, but presumably for different market reasons, bigeye prices were lower in 1998. Albacore catch declined following several years of substantial increases. Shark catch was up in

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[6] Average price is calculated as *(Ex vessel revenue / Pounds Sold)* and was recompiled to this format consistently for this year's module.

[7] Shark "catch" represent estimated whole weight, often of sharks whose dried fins were the portion actually landed.

1998, with a higher percentage landed (as a finned product) than in previous years.

Blue marlin catch declined substantially, with the decline caused by a decline in the troll-handline gear catch. (These show a substantial inter-annual variation, as discussed later.) Other catches were within the usual ranges, except for shark (estimated whole weight) which continues to increase as the market for shark fins remained strong in 1998. This market may weaken in 1999 due to the Asian economic problems.

Data: Data are combined from NMFS longline estimates and HDAR commercial catch reports for other pelagic gears. (See subsequent tables for details.) Due to rounding, totals between tables may differ.

Data Source: Imported from P8798N.xls (4/15/99) as compiled by NMFS.

Table 2. Hawaii domestic commercial pelagic catch and revenue by gear, 1997-98.

Gear	Pounds Caught (x 1,000)	Pounds Sold (x 1,000)	Ex-vessel Revenue (x $1,000)	Average Price ($/lb)
		1997		
Longline	27,100	27,100	50,000	1.85
Aku Baitboat	1,900	1,900	2,400	1.26
MHI Trolling[8]	3,000	2,500	4,500	1.80
MHI Handline[9]	1,500	1,400	3,000	2.14
Other[10]	700	600	900	1.50
TOTAL	**34,200**	**33,500**	**60,800**	**1.81**
		1998		
Longline	28,600	28,600	46,600	1.63
Aku Baitboat	700	700	900	1.29
MHI Trolling	2,200	1,900	3,600	1.89
MHI Handline	1,100	1,100	2,100	1.91
Other	1,300	1,200	1,500	1.25
TOTAL	**33,900**	**33,500**	**54,700**	**1.63**

Interpretation: Longline catch increased slightly in 1998. The total number of trips declined but as the number of tuna-directed trips increased, the total number of hooks set increased somewhat. Catch rates of the major target species for longline gear increased (swordfish and bigeye tuna). In addition, there was a higher retention of sharks (for finned product).

Pelagic handline catch in the Main Hawaiian Islands (MHI) declined substantially in 1998, as did MHI trolling. Fishing effort and catch rates require closer examination for proper interpretation.

Aku baitboat (pole-and-line skipjack tuna) declined substantially in 1998, after several years of increases.

Data: Data are from HDAR commercial catch reports for the non-longline pelagic gears and NMFS estimates for longline. HDAR commercial catch reports are categorized into Aku baitboat (pole-and-line targeting skipjack tuna); MHI handline (*ika shibi, palu ahi*, and miscellaneous handline techniques) targeting tunas; MHI trolling (targeting tunas, billfish, mahimahi, and ono); and Other -- other troll and handline locations and various other pelagic gears. Due to rounding, totals between tables may differ. Time-series data is included later in the module.

Data Source: Imported from GAS98b.dbf (3/30/99) and P8797n.xls (4/19/99).

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8 Main Hawaiian Islands (MHI) trolling only, excluding distant water trolling

9 MHI pelagic handline only, excluding seamount and NWHI handline.

10 Other includes all other pelagic gears as well as troll and handline outside the main Hawaiian Islands.

Table 3a. Hawaii longline catch and revenue, 1997-98.

Species	1997 Catch (x 1,000 lb)	1997 Revenue (x $1,000)	1998 Catch (x 1,000 lb)	1998 Revenue (x $1,000)
Blue marlin	1,074	913	851	1,073
Striped marlin	775	984	833	992
Swordfish (round weight)	6,351	14,036	7,189	11,934
Mahimahi	518	642	331	569
Ono (wahoo)	239	373	262	493
Opah (moonfish)	823	938	922	959
Sharks (round weight)	5,008	2,008	6,207	1,506
Other	509	590	640	638
Non-Tuna PMUS Subtotal	**15,297**	**20,484**	**17,235**	**18,164**
Albacore	3,619	4,451	2,449	3,037
Bigeye	5,399	17,384	7,100	21,086
Bluefin	52	805	36	253
Skipjack	234	180	168	143
Yellowfin	2,515	6,739	1,587	3,968
Tuna PMUS Subtotal	**11,819**	**29,559**	**11,340**	**28,487**
TOTAL	**27,116**	**50,043**	**28,575**	**46,651**

Interpretation: *Changes in aggregate species composition should be qualified by reference to changes in longline trip type (see following table).*

Overall longline catch has grown substantially in the past five years, with 1998 being the largest longline catch ever in Hawaii. Catch of bigeye tuna increased substantially in 1998, but the other tunas declined, with total tuna catch down slightly from 1997 (but still above the long-term average). Swordfish catch also increased although with a smaller number of targeted trips, swordfish landings remain substantially below their mid-1990s peak. The total of other pelagic species (e.g., mahimahi, ono, moonfish, and shark (fins)) was at its highest levels, but shark catch represents almost the entire increase. Shark catch increased as shark finning continues to be a major source of income, particularly for some sectors of the fishery (with crews frequently receiving most if not all of a vessel's dried shark fin revenue).

More detailed information on longline catch and effort statistics is included in the NMFS annual report on the fishery compiled by Russell Ito, Honolulu Laboratory.

Data: Data are from NMFS Honolulu Laboratory compilations based on Federal logbooks filed by domestic longliners operating out of Hawaii.

Catch is estimated by number of fish recorded as caught in the Federal longline logbooks, multiplied by the average weight per species from NMFS market monitoring in Honolulu. Data for 1998 are from preliminary average weights.

Revenue is based on whole weight prices. Swordfish and shark are adjusted to whole-weight estimates.

Data Source: Imported from LL98.xls (RYI, 4/15/99)

Table 3b. Hawaii longline catch per unit effort by trip type[11], 1997-98.

Species	1997				1998			
	All Trips	Swordfish Trips	Mixed Trips	Tuna Trips	All Trips	Swordfish Trips	Mixed Trips	Tuna Trips
Blue marlin	0.53	0.39	1.16	0.41	0.31	0.29	0.58	0.25
Striped marlin	0.81	0.58	1.17	0.75	0.83	0.42	0.87	0.85
Swordfish	2.55	15.41	9.96	0.14	2.52	14.50	9.22	0.20
Mahimahi	3.17	10.24	9.11	1.46	1.28	1.53	3.25	0.84
Moonfish	0.53	0.01	0.06	0.66	0.53	0.01	0.04	0.67
Ono (wahoo)	0.53	0.29	0.35	0.59	0.48	0.12	0.27	0.55
Sharks	5.52	14.20	16.37	2.68	5.75	23.01	12.16	3.09
Albacore	4.57	2.87	2.77	5.05	2.81	2.45	1.95	3.02
Bigeye tuna	5.13	3.13	3.12	5.68	5.69	2.33	4.81	6.13
Yellowfin tuna	1.87	1.87	3.30	1.57	1.25	0.75	1.29	1.28
Number of trips	**1,125**	**78**	**302**	**745**	**1,140**	**84**	**296**	**760**
Number of hooks set	**15,564,321**	**840,539**	**2,515,869**	**12,207,913**	**17,365,852**	**1,019,960**	**2,859,857**	**13,486,035**
Number of lightsticks	**879,431**	**292,914**	**546,249**	**40,268**	**1,223,780**	**519,595**	**654,367**	**49,818**

[Data source and Interpretation on following page]

[11] Trip type refers to the primary species target for each trip. (See *Data* description below).

Interpretation: This table shows the substantial difference in interpretation that categorization of CPUE by trip type can make. Swordfish trips have twice the swordfish CPUE as Mixed trips, while swordfish is a small incidental catch in Tuna trips. The aggregate (All Trips) CPUE figures are not good indicators of catchability or abundance, although they do indicate the relative importance of particular species within the fishery as a whole.

Swordfish trip CPUE for swordfish increased in 1998, although somewhat fewer swordfish-directed hooks were set in 1998 than in 1996. Mixed trip CPUE for swordfish increased as well, although Mixed trip hooks set decreased. More lightsticks were used per set in both Swordfish and Mixed trips. Mixed CPUEs for albacore and bigeye declined and were not as high in 1998 as in 1996 or 1995, but yellowfin catch rates were higher.

Catch of shark remains relatively high in Swordfish and Mixed trips (compared to target species), but relatively low in Tuna trips. Shark CPUEs were lower in 1998 than in 1996. Approximately 55% of all sharks were retained (most as fins).

Mahimahi was much more available in 1998 compared to 1996 (a typical pattern of biannual variation in apparent abundance catchability), while most other pelagic species were about the same.

Tuna trip CPUEs for albacore, bigeye, and yellowfin were higher in 1998. The number of hooks set by Tuna trips continues to increase. Mixed trips appear to have targeted swordfish more in 1998.

More detailed information on longline CPUE statistics will be included in the NMFS annual report on the fishery being compiled by Russell Ito, Honolulu Laboratory.

Data: Data are from NMFS Honolulu Laboratory compilations based on Federal logbooks filed by domestic longliners operating out of Hawaii. ***CPUE*** is the number of fish caught per 1,000 longline hooks. *Trip Type* refers to the identification of the primary target species for a particular trip, either as indicated by the vessel captain to NMFS logbook collection staff or designated by NMFS in the absence of a captain's designation.

Data Source: NMFS longline logbook summaries (LLCS 4/22/99).

Table 3c. Hawaii longline catch (number of fish caught) by area fished[12], 1997-98.

Species	1997 All Locations	1997 MHI EEZ	1997 NWHI EEZ	1997 Outside of U.S. EEZs	1998 All Locations	1998 MHI EEZ	1998 NWHI EEZ	1998 Outside of U.S. EEZs
Blue marlin	8,255	4,085	1,519	2,457	5,350	1,698	1,217	2,125
Striped marlin	12,637	4,193	4,109	4,080	14,347	4,856	5,757	3,408
Swordfish	39,682	4,873	5,148	29,627	43,776	4,721	10,611	28,269
Mahimahi	49,319	11,660	6,321	30,730	22,183	7,664	3,527	10,157
Moonfish	8,254	2,847	2,887	2,314	9,184	3,585	1,862	3,462
Ono (wahoo)	8,312	2,525	1,789	3,668	8,281	2,305	761	4,068
Sharks	85,838	16,476	17,921	49,935	99,919	14,685	20,152	59,180
Albacore	71,084	19,025	17,118	30,887	48,833	12,482	6,802	25,621
Bigeye tuna	79,784	21,397	30,168	26,149	98,795	26,723	16,629	37,762
Yellowfin tuna	29,045	10,982	5,139	10,990	21,721	4,678	2,713	8,004
Trips[13]	**1,162**	**687**	**390**	**660**	**1,181**	**581**	**305**	**734**
Hooks (1,000s)	**15,564**	**5,057**	**4,096**	**5,969**	**17,366**	**4,970**	**3,095**	**7,362**
Lightsticks (1,000s)	**879**	**132**	**128**	**619**	**1,224**	**99**	**310**	**814**

MHI: Main Hawaiian Islands
NWHI: Northwestern Hawaiian Islands
EEZ: Exclusive Economic (200-mile) Zone

[Data source and Interpretation on following page]

12 Only the three areas with the largest catch are tabled here. The balance reflects catch in U.S. possessions or catch where locations were not verified.

13 Total trips are not additive across areas because trips may intersect more than one area. Totals may also differ between tables because of different data compilation dates.

Interpretation: Longline fishing effort (as measured by number of hooks set) increased by about 10% in 1998. However the locations of that effort changed again. Fishing effort shifted away from NWHI (outside the 50 mile protected species zone) with 25 % fewer hooks in 1998 and increased substatially at the Pacific remote island territories (particularly Palmyra Atoll/Kingman Reef) which constituted 11% of longline fishing effort in 1998. Fishing outside the U.S. EEZs increased about 15% and effort in the MHI remained the same.

Bigeye tuna were caught in record numbers in 1998 (25 % increase for the past two years), but albacore and yellowfin were down about one third from 1997. Most bigeye tuna was caught outside the U.S. EEZ this year, whereas it was primarily caught within the MHI or NWHI EEZs in earlier years. Slightly more than half the albacore is caught outside the EEZs. About 30 % of the yellowfin caught was at the Pacific remote island territories while another 35 % was caught outside the U.S. EEZs.

As would be expected, most swordfish was caught outside the EEZs. There was a 60 % decrease in the catch of blue marlin within the MHI EEZ which accounts for most of the drop in total catch.

The number of shark caught increased by 18 % in 1998. Over half the sharks were caught outside the Hawaii EEZs, confirming the relatively pelagic and migratory nature of the blue sharks which predominate in the catch (93% of all sharks caught).

More detailed information on longline catch and effort statistics will be included in the NMFS annual report on the fishery being compiled by Russell Ito, Honolulu Laboratory.

Data: Catch is *Number Caught* based on Federal logbooks filed by domestic longliners operating out of Hawaii. The Main Hawaiian Islands (MHI) EEZ (Exclusive Economic Zone) represents all longline catch within 200 miles of the eight main islands of Hawaii, except for the overlap with the Northwestern Hawaiian Islands (NWHI). Catch in other U.S. EEZ areas includes the EEZs for U.S. possessions in the central and western Pacific (e.g., Wake Island).

Data Source: NMFS longline logbook summaries (LLCS 4/22/99)

Table 4a. Average estimated round weight (in pounds) of fish by longline, 1987-98.

	Non-Tuna PMUS					Tunas			
Year	Swordfish	Blue marlin	Striped marlin	Mahimahi	Wahoo (ono)	Albacore	Bigeye	Skipjack (aku)	Yellowfin
1987	129	161	66	21	33	62	76	18	82
1988	119	157	57	20	32	60	83	19	103
1989	131	165	62	23	35	62	77	19	104
1990	148	198	62	19	36	61	80	21	122
1991	155	175	59	15	32	52	85	20	118
1992	178	175	66	11	35	45	77	17	99
1993	172	157	64	13	33	44	88	17	92
1994	163	171	64	12	34	41	81	18	97
1995	171	157	58	10	31	50	79	18	95
1996	157	154	58	17	31	53	64	17	80
1997	163	134	66	13	30	54	71	20	89
1998	**176**	**164**	**60**	**16**	**32**	**55**	**74**	**20**	**76**
Average	155	164	62	16	33	53	78	19	96
Standard Deviation	19.6	15.4	3.4	4.2	1.9	7.3	6.4	1.4	14.1

[Data source and Interpretation on following page]

Interpretation: Analysis of any changes in size composition for species which are caught in multiple locations (e.g., MHI vs. out of the EEZ) is difficult without identification of the catch location. What is significant about the average sizes is the relatively slight change in average weight over time and the relatively small standard deviations for most species. Average swordfish weights were amongst their highest in 1997, while blue marlin were the smallest over the time series. This may be explained by the fact that relatively more blue marlin were caught outside the EEZ in 1997 compared to 1996.

More detailed analysis of weight composition is found in NMFS annual longline monitoring reports.

Data: Longline data are from NMFS Honolulu Laboratory market monitoring. Where fish are presented in less than whole form, conversion factors are applied to convert to whole weight. This is not frequent for longline catch (except for swordfish). Sharks are not included in this average weight table because of inadequate samples (most shark is "landed" only as a finned product.)

Data source: Imported from LL98A.xls (3/30/99)

Table 4b. Average estimated round weight (in pounds) of fish for troll-handline-other gears, 1987-98.

	Non-Tuna PMUS					Tunas			
Year	Swordfish	Blue marlin	Striped marlin	Mahimahi	Ono (wahoo)	Albacore	Bigeye	Skipjack (aku)	Yellowfin
1987	126	215	66	21	24	33	14	7	32
1987	124	181	64	18	25	64	34	7	32
1988	107	188	68	21	25	55	24	11	44
1989	97	248	76	20	25	58	25	7	41
1990	122	197	63	15	23	53	29	9	34
1992	75	215	70	14	26	53	28	6	27
1993	139	182	67	14	24	55	22	7	44
1994	95	233	67	14	27	53	30	9	37
1995	110	204	61	16	24	22	18	7	30
1996	86	195	65	16	23	42	24	12	42
1997	96	175	68	16	21	40	19	11	34
1998	**89**	**208**	**56**	**18**	**26**	**20**	**20**	**5**	**27**
Average	106	203	66	17	24	46	24	8	35
Standard Deviation	19.2	21.9	4.9	2.6	1.6	14.3	5.7	2.2	6.2

[Data source and Interpretation on following page]

Interpretation:

Most species are within their 10-year ranges although swordfish, striped marlin, albacore, and yellowfin tuna were somewhat below their averages and there does appear to be a trend towards smaller swordfish in the troll-handline-other gear category. Blue marlin was substantially larger in 1998 than in recent years, but still only about its longer term average.

Data: Troll-handline-other gear data are from HDAR commercial catch reports (*pounds caught* divided by *number caught* where *number caught* > *0*). Correction cannot be made for weights of processed fish (e.g., headed and gutted) which might have been recorded in processed form. Average weight is calculated as Pounds Caught *divided by* Number Caught. *Other* gear represents all other gears except troll, handline, longline, and baitboat. In 1995 albacore catch and weights are strongly influenced by distant-water albacore troll catch.

Data source: annual GASyr.dbf (4/22/99)

Table 5a. Hawaii longline vessel activity (trips), 1991-1998.

Year	# vessels	Total Trips	Tuna Trips	Mixed Trips	Swordfish Trips
1991	141	1,671	556	823	292
1992	123	1,266	458	531	277
1993	122	1,192	542	331	319
1994	125	1,106	568	228	310
1995	110	1,125	682	307	136
1996	103	1,100	657	351	92
1997	105	1,125	745	302	78
1998	**114**	**1,140**	**760**	**296**	**84**
Average	118	1,216	621	396	199
Standard Deviation	12	192	107	193	110

Interpretation: This table shows the decline in the number of longline trips in Hawaii from the moratorium on new entry in 1991 through 1994, at which point trip effort stabilized. The table also shows the dramatic shift from swordfish-targeted trips toward tuna (primarily bigeye tuna) and mixed trips in 1995, and the decline of swordfish-directed fishing effort. As a result of this shift, interpretation of longline catch statistics should reflect the changing nature of longline targeting practices.

Data: Data compiled by the NMFS Honolulu Laboratory's Fishery Monitoring & Economics Program from NMFS Federal logbooks. Type of trip is usually determined by interview with the vessel captain or occasionally by FMEP staff interpretation of salient characters from fishing vessel gear design, fishing locations, and catch composition. Detailed longline effort data is only available beginning in the 1991 calendar year when Federal logbooks went into effect.

Data Source: NMFS longline logbook summaries (LLCS 4/22/99)

Table 5b. Hawaii longline vessel activity (miles to first set and days fishing), 1991-1998.[14]

	All Trips			
	Average		Maximum	
Year	Miles to first set	Days fishing	Miles to first set	Days fishing
1991	318	7.6	1,792	22
1992	424	9.5	1,871	26
1993	465	10.3	2,122	29
1994	430	10.0	2,814	26
1995	441	10.2	2,097	27
1996	367	10.5	2,037	30
1997	332	10.5	1,973	36
1998	**422**	**10.9**	**1,611**	**24**
Average	400	9.9	2,040	28
Standard Deviation	54	1.0	356	4

[14]Data not corrected for vessels starting trips in California and ending in Hawaii.

	Average					
	Tuna Trips		Mixed Trips		Swordfish Trips	
Year	Miles to first set	Days fishing	Miles to first set	Days fishing	Miles to first set	Days fishing
1991	240	7.7	276	6.3	585	10.7
1992	260	8.4	404	7.8	733	12.7
1993	222	8.8	522	9.6	820	13.7
1994	252	8.9	323	8.0	833	13.4
1995	273	10.0	397	9.3	884	13.2
1996	284	10.3	410	10.3	790	12.7
1997	288	10.1	365	10.6	623	14.1
1998	**384**	**10.3**	**439**	**11.9**	**708**	**14.5**
Average	275	9.3	392	9.2	747	13.1
Standard Deviation	49	1.0	74	1.8	105	1.2

	Maximum					
	Tuna Trips		Mixed Trips		Swordfish Trips	
Year	Miles to first set	Days fishing	Miles to first set	Days fishing	Miles to first set	Days fishing
1991	1,508	18	1,408	22	1,792	26
1992	1,156	14	1,543	21	1,871	26
1993	1,432	14	1,616	23	2,122	29
1994	945	16	1,298	19	2,814	26
1995	945	20	1,609	26	2,097	27
1996	1,866	28	1,547	30	2,037	28
1997	1,002	19	1,323	36	1,973	27
1998	**1,154**	**17**	**1,611**	**24**	**1,522**	**24**
Average	1,251	18.3	1,494	25.1	2,029	26.6
Standard Deviation	326	4.5	132	5.5	372	1.5

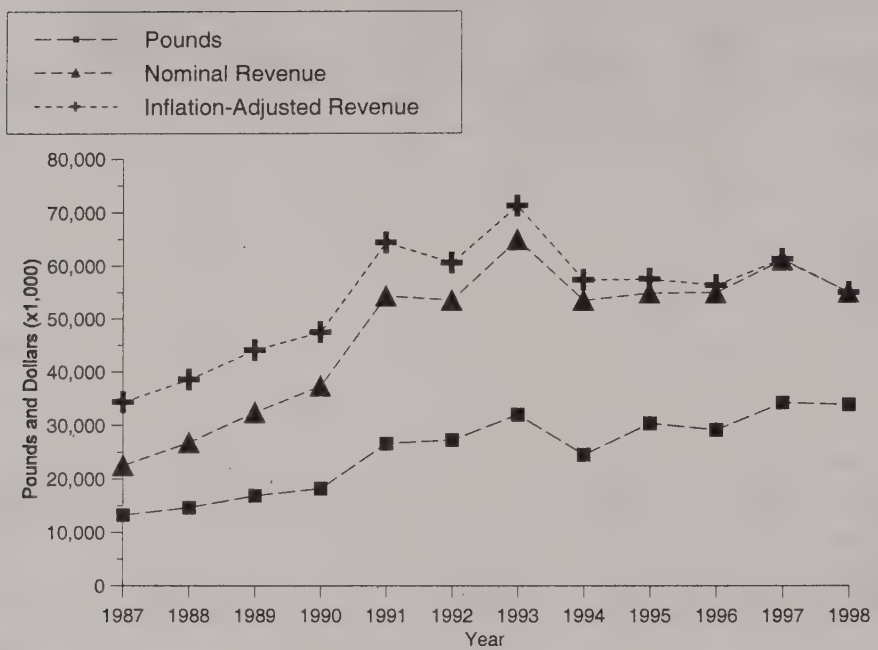
Interpretation: These tables show an increase in the average miles to first set and the number of days fishing for all three target trips, and an increase in the maximum distance to first set by the tuna and mixed target vessels. Swordfish boats may have lower miles to first set since more vessels fishing further to the east may be offloading in California (and thus not included in this data base).

Data: Data compiled by the NMFS Honolulu Laboratory's Fishery Monitoring & Economics Program from NMFS Federal logbooks. Type of trip is determined by FMEP staff through interviews with vessel captains or categorization of fishing operations.

Miles to first set is determined as the distance from Honolulu to the first set as recorded on the logbook. Average days fishing is determined by the number of days on which sets and hauls occurred on an individual trip.

Source: NMFS Honolulu Laboratory FMEP programming (5/5/99)

Figure 1. Hawaii commercial pelagic landings and revenue (all gears and pelagic species), 1987 - present.



Interpretation: Total pelagic landings (bottom line) and revenue (top lines) data show the effect of the dramatic increase in longline landings from the mid-1980s through 1993 and the general stabilization of landings and revenue since then. Gear-specific changes are considered in later figures.

Data source on following page.

Hawaii commercial pelagic landings and revenue (all gears and species).

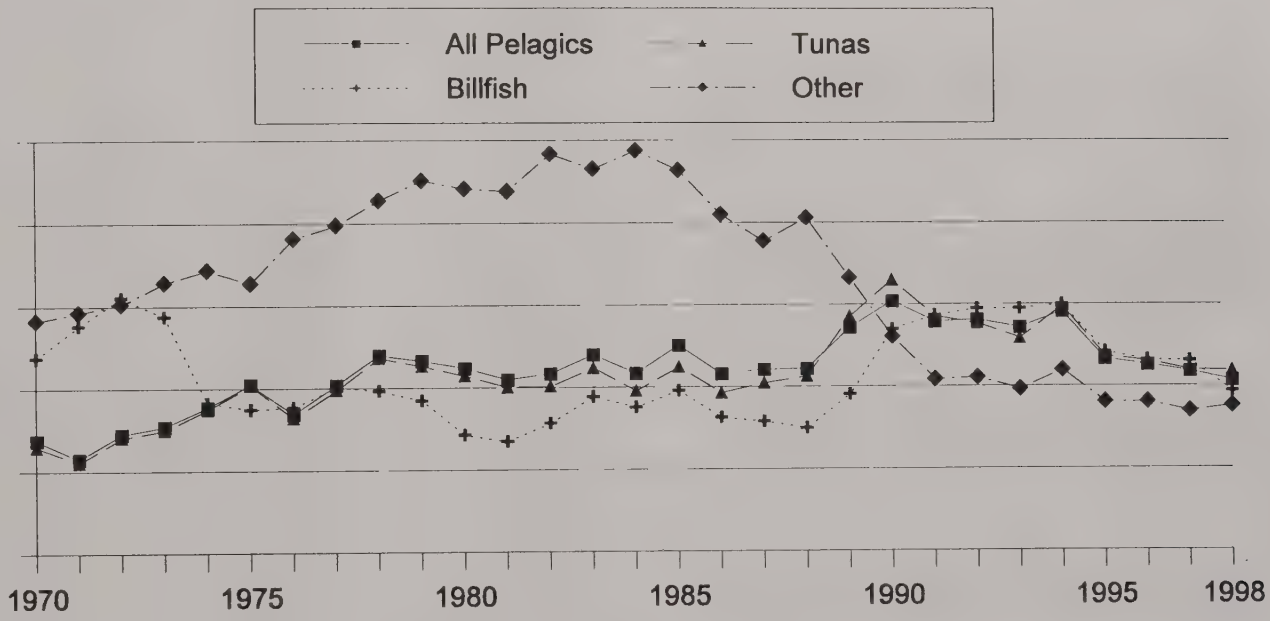
Year	Pounds (x 1,000)	Nominal Revenue (x$1,000)	Adjusted Revenue (x $1,000)	Honolulu Consumer Price Index (W)
1987	13,337	$22,597	$34,393	115.90
1988	14,733	$26,873	$38,603	122.80
1989	16,960	$32,442	$44,124	129.70
1990	18,291	$37,399	$47,497	138.90
1991	26,648	$54,306	$64,336	148.90
1992	27,296	$53,483	$60,517	155.90
1993	32,015	$64,853	$71,190	160.70
1994	24,576	$53,422	$57,218	164.70
1995	30,381	$54,781	$57,384	168.40
1996	29,155	$54,803	$56,173	172.10
1997	34,194	$60,879	$61,053	175.90
1998	**33,841**	**$54,810**	**$54,810**	**176.40**
Average	25,100	$47,600	$53,900	
Standard Deviation	7,200	$13,300	$10,300	

Data: Data are compiled from Hawaii Division of Aquatic Resources (HDAR) commercial catch reports for non-longline landings and from NMFS estimates of longline landings. Inflation-adjusted revenue (Revenue*) is computed from the Honolulu consumer price index (HCPI) as: (Current year HCPI / data year HCPI) X (data year nominal ex-vessel revenue)[15]

Data Source: P8798n.xls (4/22/99)

[15] The same adjustment can be done on price data.

Figure 2. Hawaii commercial ex-vessel pelagic prices, inflation-adjusted, 1970 - present.



Interpretation

Inflation-adjusted pelagic prices have declined for all major species groups over the past five years from peaks in the early 1990s. The market for tuna has weakened due to the decline in tourists arriving from Japan and due to a weak export demand. Swordfish prices also fell substantially on the U.S. East coast. An addendum to the Hawaii Fishing Industry and Vessel Economics project under the JIMAR Pelagic Fisheries Research Program is investigating price movements over the past few years; results should be available for next year's annual report.

Hawaii commercial pelagic prices, inflation-adjusted [16].

Year	All Pelagics	Tuna	Billfish	Other	HCPI
1970	$1.38	$1.30	$2.38	$2.83	$114.20
1971	$1.15	$1.11	$2.77	$2.93	$118.90
1972	$1.45	$1.41	$3.11	$3.03	$122.80
1973	$1.54	$1.50	$2.88	$3.29	$128.30
1974	$1.77	$1.75	$1.83	$3.44	$141.90
1975	$2.05	$2.04	$1.75	$3.28	$155.00
1976	$1.69	$1.64	$1.77	$3.82	$162.80
1977	$2.04	$1.98	$2.02	$3.98	$171.80
1978	$2.40	$2.37	$1.97	$4.28	$184.10
1979	$2.33	$2.27	$1.85	$4.52	$204.50
1980	$2.24	$2.15	$1.43	$4.42	$228.70
1981	$2.10	$2.01	$1.35	$4.39	$252.80
1982	$2.17	$2.02	$1.57	$4.84	$268.10
1983	$2.40	$2.24	$1.89	$4.66	$275.90
1984	$2.17	$1.96	$1.76	$4.88	$284.80
1985	$2.51	$2.25	$1.96	$4.64	$301.40
1986	$2.16	$1.93	$1.63	$4.10	$308.20
1987	$2.21	$2.05	$1.58	$3.78	$323.80
1988	$2.22	$2.13	$1.50	$4.06	$343.05
1989	$2.72	$2.86	$1.91	$3.33	$355.90
1990	$3.04	$3.30	$2.70	$2.61	$380.35
1991	$2.79	$2.86	$2.87	$2.09	$412.50
1992	$2.81	$2.77	$2.95	$2.11	$432.00
1993	$2.72	$2.59	$2.95	$1.97	$445.30
1994	$2.91	$2.98	$3.00	$2.20	$456.30
1995	$2.33	$2.37	$2.42	$1.81	$467.60
1996	$2.26	$2.31	$2.32	$1.81	$476.90
1997	$2.18	$2.20	$2.31	$1.70	$487.40
1998	**$2.07**	**$2.19**	**$1.94**	**$1.76**	**$499.59**
Average	2.20	2.16	2.15	3.33	
Std Deviation	0.45	0.50	0.53	1.05	

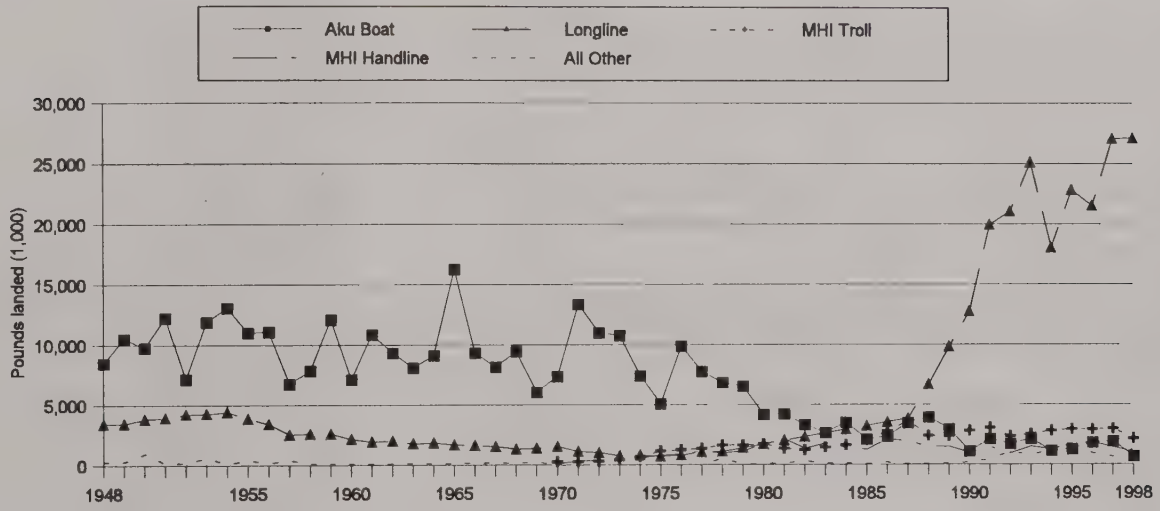
Data

Data are compiled from Hawaii Division of Aquatic Resources (HDAR) commercial catch reports. Nominal price is calculated as (ex vessel) revenue / pounds sold. Inflation-adjusted price is calculated from the Honolulu consumer price index (CPI) as: (Current year CPI / data year CPI) * data year nominal price. No adjustments are made in this table for product form (e.g., most swordfish prices in HDAR are reported as headed, gilled, and gutted, not raised to whole weights. This increases the reported average billfish price.) or for under-reporting by some gear types (e.g., longline in the early 1980s.)

Data source: PPRICE.xls (5/3/99)

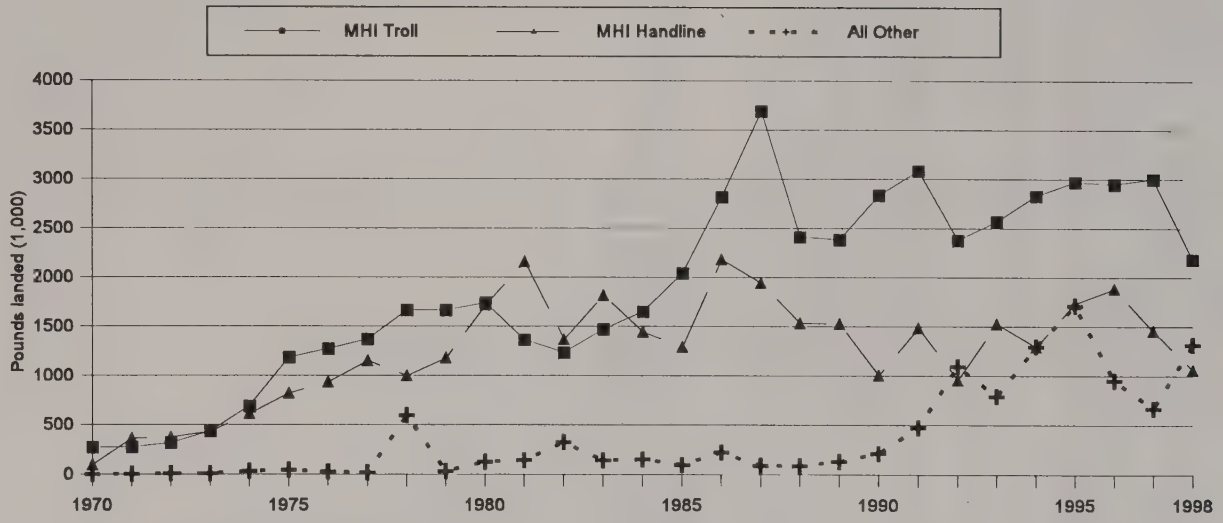
[16] Each years' inflation-adjusted price data must be updated annually.

Figure 3a. Hawaii commercial pelagic landings by major gear types.



Interpretation: This figure shows the long-term decline of the aku boat (pole-and-line skipjack tuna) fishery from its peak in the mid-1960s through the closure of the Hawaiian Tuna Packers (Bumble Bee Tuna) cannery in 1984. The aku boat fishery declined for a variety of issues, primarily economic. The figure also shows the rise of the troll-handline fishery in the mid-1970s (see following figure) and the rapid rise of the longline fishery in the late 1980s. The longline fishery now dominates pelagic landings and all other fisheries in the state.

Figure 3b. Troll-Handline-Other Gears Pelagic Landings, 1970 - present.



Interpretation:

This figure attempts to "interpret" the troll, handline and other categories of pelagic landings in Hawaii. Trolling in the main Hawaiian Islands for pelagics declined sharply in 1998 after having remained steady in terms of landings over the past 10 years. The same was true for main Hawaiian Islands handline tuna (ika shibi and palu ahi in the near-shore areas), after a substantial rise in the mid-1990s. Other pelagic landings (by other gears and by troll and handline from a variety of areas[17]) have fluctuated substantially. The result is that total troll-handline-other pelagic landings in 1998 were not substantially different from the early 1990s.

Comparing landings in 1995 (the largest for Other Gears - Other Areas and near largest for MHI handline) with 1997 is instructive.

In 1995, Other pelagic gear landings were almost 50% non-MHI pelagic handline (Cross Seamount?) and a similar amount identified as Other Gears - Other Areas (distant-water albacore trollers?). The non-MHI pelagic handline landings were predominately yellowfin tuna (587,000 pounds) and bigeye tuna (102,000 pounds). The Other Gears - Other Areas landings were almost entirely albacore (815,000 pounds). Almost all of the Trolling landings were recorded in the MHI.

In 1997, the non-MHI handline pelagic landings were simply lower. Whereas in the 1997 annual report there were questions about the Other landings, it appears that the apparent decline in 1997 was half reporting delinquency, half decline in catch.

[17] Includes NWHI landings by these gear types, distant-water albacore trollers, and Cross Seamount handline when reported separately.

Table 6. Hawaii commercial fishing landings, pelagics by gear type, 1948 - present. HDAR figures and NMFS estimates (all species).

Year	Aku boat	Longline	Total Troll-Handline-Other
1948	8,496	3,476	297
1949	10,541	3,491	332
1950	9,788	3,859	976
1951	12,264	3,970	183
1952	7,181	4,290	247
1953	11,914	4,332	646
1954	13,104	4,448	161
1955	11,020	3,898	449
1956	11,120	3,443	217
1957	6,765	2,571	453
1958	7,856	2,645	156
1959	12,122	2,636	132
1960	7,138	2,173	150
1961	10,878	1,972	148
1962	9,349	2,022	154
1963	8,096	1,811	171
1964	9,134	1,883	167
1965	16,295	1,707	170
1966	9,339	1,655	198
1967	8,164	1,563	226
1968	9,463	1,353	195
1969	6,072	1,416	273

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(continued)

Year	Aku Boat	Longline	MHI Troll	MHI Handline	Other	Total Troll-Handline-Other
1970	7,386	1,541	275	102	2	379
1971	13,393	1,151	279	368	7	654
1972	11,001	1,055	321	378	11	710
1973	10,766	778	436	437	12	885
1974	7,427	830	692	619	36	1,347
1975	5,088	746	1,188	825	47	2,060
1976	9,896	838	1,273	938	30	2,241
1977	7,780	1,101	1,372	1,156	20	2,548
1978	6,849	1,125	1,669	1,002	600	3,272
1979	6,549	1,432	1,667	1,186	35	2,889
1980	4,194	1,740	1,743	1,723	126	3,592
1981	4,229	2,047	1,368	2,164	145	3,947
1982	3,342	2,355	1,238	1,374	328	2,941
1983	2,683	2,663	1,473	1,823	145	3,442
1984	3,527	2,970	1,655	1,449	153	3,257
1985	2,114	3,278	2,046	1,294	99	3,439
1986	2,351	3,585	2,820	2,186	226	5,232
1987	3,503	3,893	3,693	1,947	94	5,737
1988	3,943	6,733	2,414	1,537	91	4,038
1989	2,962	9,844	2,386	1,531	132	4,046

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Year	Aku Boat	Longline	MHI Troll	MHI Handline	Other	Total Troll-Handline-Other
1990	1,116	12,790	2,838	1,009	214	4,128
1991	2,146	19,970	3,087	1,490	474	5,054
1992	1,735	21,090	2,381	961	1,098	4,439
1993	2,137	25,160	2,572	1,533	793	4,896
1994	1,159	18,110	2,833	1,297	1,298	5,428
1995	1,291	22,850	2,973	1,742	1,716	6,433
1996	1,844	21,540	2,951	1,888	953	5,792
1997	1,947	27,120	3,003	1,460	668	5,133
1998	**696**	**27,148**	**2,188**	**1,062**	**1,319**	**4,570**
Average 1948-present	6,846	6,002	1,891	1,258	375	3,535
Standard Deviation	3,981	7,749	957	543	478	1,672

Data: Data are compiled from HDAR commercial catch reports using a data summarization program (HEPS.prg) maintained by the Fishery Monitoring and Economics Program of the NMF Honolulu Laboratory.

Gears are categorized in this report as follows:

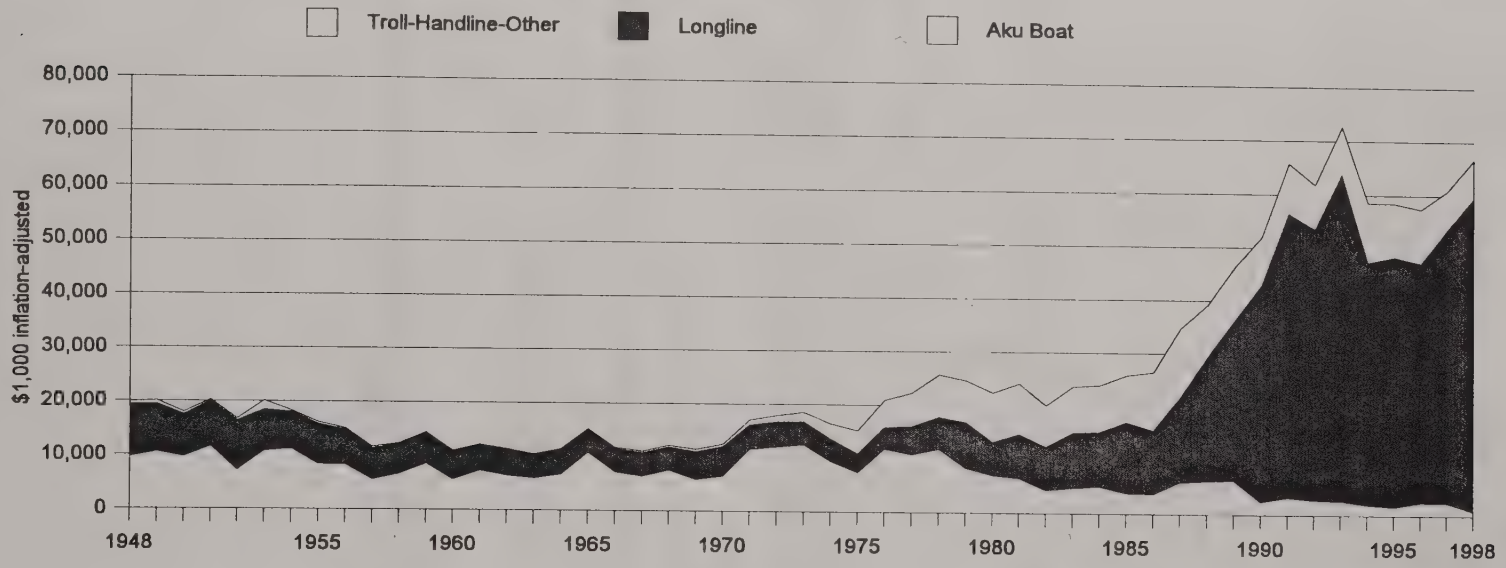
Trolling:	Gear 6 in HDAR codes
Handline:	Gears 3 (Deepsea handline), 8 (Ika Shibi), 9 (Palu Ahi), and 35 (Drifting/Pelagic handline)
Other:	All remaining gears (except Longline and Aku Boat)

Areas are categorized as follows:

MHI:	HDAR Areas 100-699
Other:	Includes NWHI, the periphery of the MHI (usually outside of one-degree square of the MHI), and all other fishing locations.

Data Source: P8798N.xls (4/22/99)

Figure 4. Hawaii commercial fishing revenue, adjusted for inflation, 1948 - present.



Interpretation: On an inflation-adjusted ex-vessel revenue basis, the dominance of the longline fleet beginning in the late 1980s is clearly shown. Approximately 80% of all commercial pelagics revenue comes from the longline fishery, compared to less than 30% in 1980. Longline revenue dipped significantly in 1994 as a number of vessels returned to the mainland U.S., but most of this decline has been subsequently recovered through tuna landings. In fact, 1998 was the second highest year for inflation-adjusted revenue in the longline fishery. Troll-handline-other pelagic landings were near their long-term average but still significantly below their 1994-1996 highs. These fisheries have shown substantial variation over the past twenty years.

Data source on following pages.

Hawaii commercial fishing revenue*, adjusted for inflation, 1948 - present.

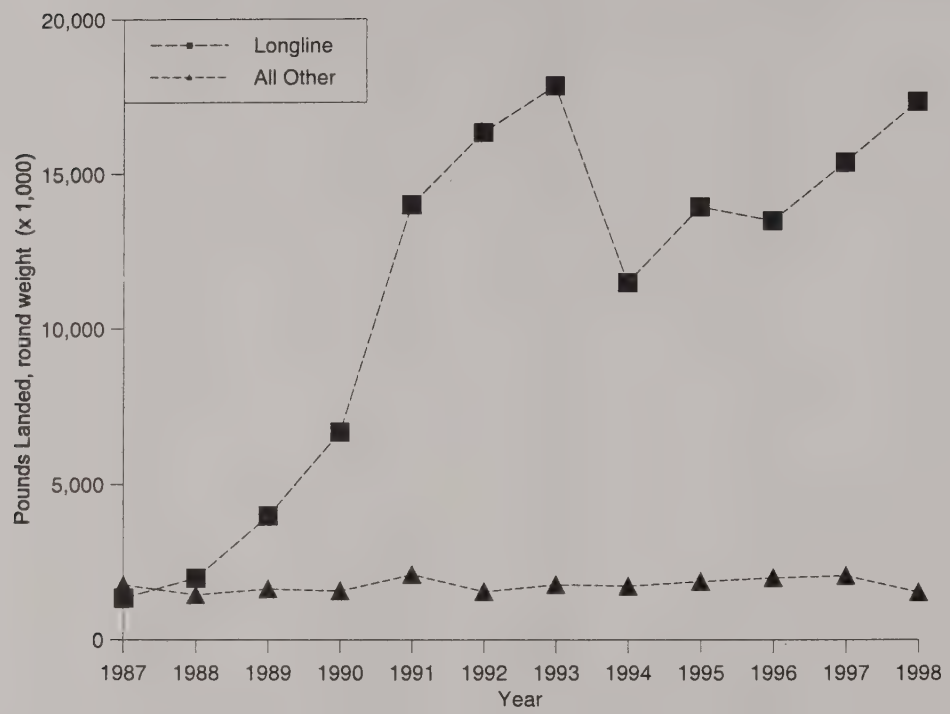
Year	Aku Boat	Longline	Troll-Handline-Other
1948	9,688	9,689	585
1949	10,589	8,888	631
1950	9,653	7,895	441
1951	11,607	8,387	331
1952	7,202	9,242	410
1953	10,774	7,670	1,695
1954	11,192	6,939	228
1955	8,388	7,493	325
1956	8,272	6,559	333
1957	5,592	5,796	304
1958	6,665	5,524	223
1959	8,590	5,732	178
1960	5,644	5,237	232
1961	7,322	4,682	209
1962	6,439	4,811	226
1963	5,931	4,412	216
1964	6,684	4,610	220
1965	10,782	4,267	217
1966	7,217	4,333	277
1967	6,424	4,420	295
1968	7,576	4,335	308
1969	5,873	5,244	437
1970	6,549	5,515	503
1971	11,567	4,597	962
1972	11,997	4,770	1,208
1973	12,472	4,355	1,744
1974	9,421	4,260	2,802

Year	Aku Boat	Longline	Troll-Handline-Other
1975	7,355	3,566	4,345
1976	11,744	4,106	5,146
1977	10,780	5,260	6,261
1978	11,826	6,014	7,927
1979	8,399	8,513	7,798
1980	6,988	6,313	9,131
1981	6,537	8,258	9,385
1982	4,344	8,138	7,646
1983	4,737	10,363	8,641
1984	5,068	10,248	8,681
1985	3,814	13,319	8,744
1986	3,681	11,994	10,830
1987	5,937	15,855	12,956
1988	6,214	23,187	9,846
1989	6,416	29,861	10,034
1990	2,460	40,515	9,029
1991	3,277	53,071	9,424
1992	2,793	50,745	8,311
1993	2,709	61,009	9,037
1994	2,009	45,394	11,182
1995	1,656	46,796	10,061
1996	2,503	44,794	10,124
1997	2,442	51,189	7,297
1998	**932**	**58,620**	**7,226**
Average	6,956	15,231	4,404
Std. Deviation	3,141	17,212	4,318

Data: Combination of HDAR commercial catch reports for non-longline gears and NMFS estimates for longline.

Data Source: HTOT98a.xls (4/22/99)

Figure 5. Hawaii commercial billfish and other non-tuna PMUS catch by gear type, 1987 - present



Interpretation: The chart shows the rapid rise in the longline fishery for swordfish in 1991-93, the decline from 1994-96 as swordfish longliners returned to the mainland U.S., and the recovery in 1997-98 as more vessels targeted swordfish again. Swordfish rose from 4 % of longline landings of non-tunas in 1987 to 42 % in 1998. In addition, the non-tuna PMUS includes the estimated round weight of pelagic sharks (e.g., blue sharks) which are caught incidentally and processed at-sea only for their fins. This amounted to approximately 36% of non-tuna longline landings in 1998. More information is obtainable from the species tables and from the NMFS annual report on the fishery (Ito, 1999).

The chart also shows the relative stability of non-tuna PMUS catch by all the other gears. However landings by troll-handline-other pelagic gears in 1998 was below the recent average although 1997 was a relatively high year.

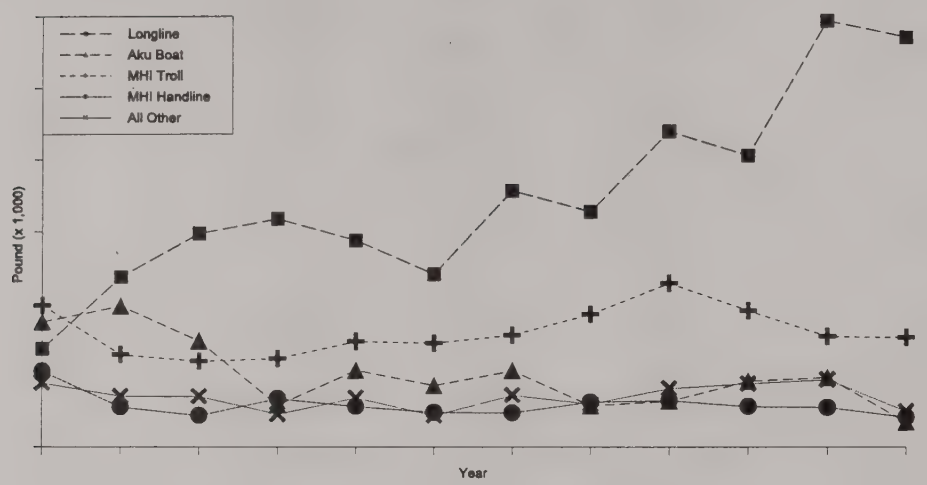
Hawaii commercial billfish and other non-tuna PMUS catch by gear type.

Year	Pounds Landed (x 1,000)	
	Longline	All Other
1987	1,350	1,776
1988	2,000	1,459
1989	4,000	1,648
1990	6,700	1,586
1991	14,000	2,105
1992	16,320	1,558
1993	17,810	1,784
1994	11,460	1,734
1995	13,890	1,882
1996	13,430	2,001
1997	15,297	2,063
1998	**17,235**	**1,528**
Average	11,124	1,760
Standard Deviation	6,007	216

Data: Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports.

Data Source: P8798N.cal (4/20/99)

Figure 6. Hawaii commercial tuna catch by gear type, 1987 - present.



Interpretation: Since 1993, longline fishing effort increasingly has focused on tuna as a target species (as described in Ito, 1996). Aku boat landings dropped dramatically in 1998. MHI troll landings are slightly below their long-term average while MHI handline were down more substantially.

The time-series now illustrates the fluctuating importance (or reporting) of all other gears, including NWHI trolling and handline, off-shore handline, and distant-water troll.

In 1998, most of the All Other tuna landings were primarily off-shore handline (probably the seamounts): 110,000 pounds of albacore, 310,000 pounds of bigeye and 435,000 pounds of yellowfin. Albacore landings by Other gears-Other areas were 303,000 pounds (probably distant-water trollers).

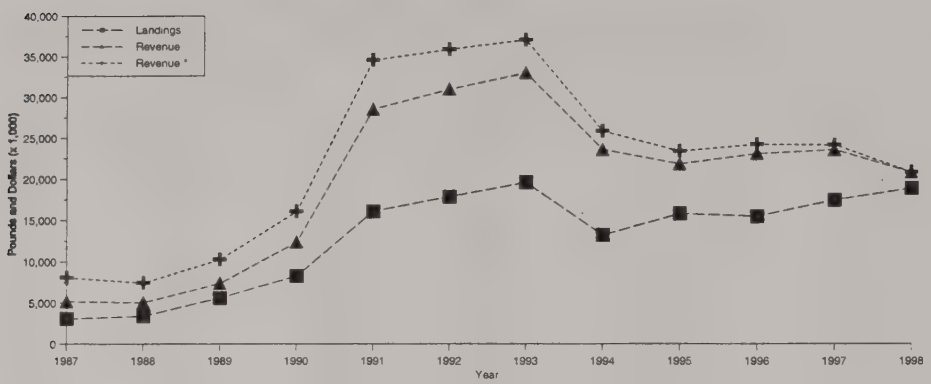
Hawaii commercial tuna catch by gear type.

Year	Pounds Caught (x 1,000)				
	Longline	Aku boat (Pole-and-line baitboat)	MHI Troll	MHI Handline	All Other
1987	2,750	3,501	3,960	2,127	1,799
1988	4,750	3,936	2,588	1,124	1,428
1989	5,950	2,961	2,401	891	1,423
1990	6,350	1,180	2,475	1,361	926
1991	5,750	2,147	2,946	1,139	1,383
1992	4,810	1,722	2,896	976	889
1993	7,120	2,134	3,117	962	1,455
1994	6,530	1,158	3,694	1,263	1,208
1995	8,770	1,290	4,549	1,301	1,642
1996	8,090	1,843	3,791	1,138	1,768
1997	11,819	1,942	3,073	1,110	1,883
1998	**11,340**	**696**	**3,041**	**835**	**1,000**
Average	7,002	2,042	3,211	1,186	1,400
Standard Deviation	2,656	983	656	338	340

Data: Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports.

Data Source: P8798N.cal (4/20/99)

Figure 7. Hawaii billfish & other non-tuna PMUS catch and revenue, 1987 - present.



Interpretation: Following several low years in the mid-1990s, longline landings of swordfish increased in 1998 so that total non-tuna PMUS landings reached near-record levels. However ex-vessel (nominal) revenue was lower than at any time over the past eight years due to the decline in swordfish prices ($1.66 in 1998 compared to $2.21 in 1997).

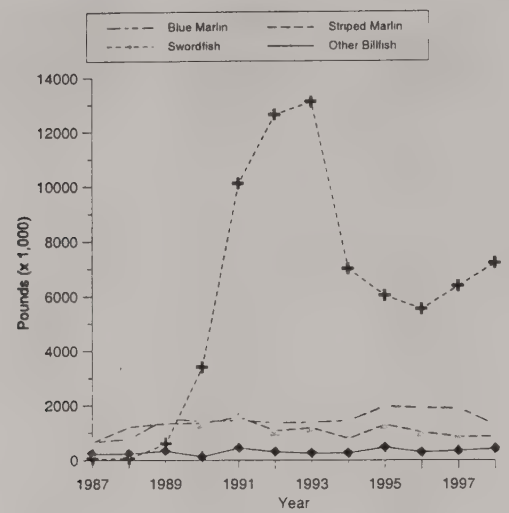
Hawaii billfish & other non-tuna PMUS catch and revenue, 1987 - present.

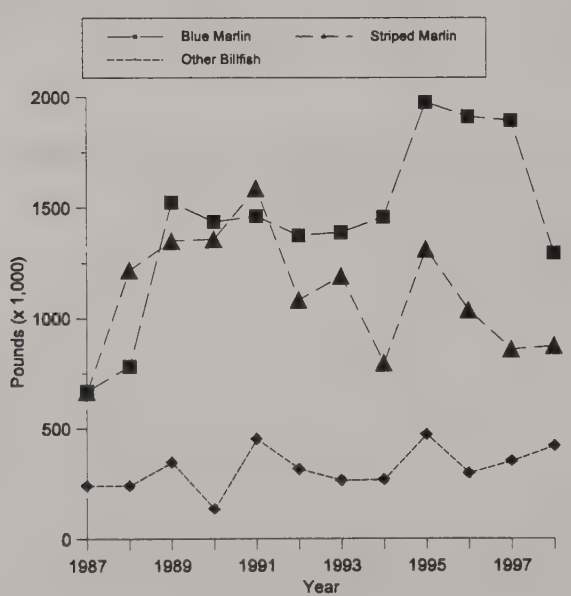
Year	Pounds (x1,000)	Nominal Revenue ($,1000)	Inflation-adjusted Revenue ($1,000)	HCPI
1987	3,126	5,207	8,105	116
1988	3,459	5,093	7,482	123
1989	5,648	7,410	10,307	130
1990	8,286	12,415	16,124	139
1991	16,105	28,530	34,566	149
1992	17,878	30,955	35,820	156
1993	19,594	32,929	36,966	161
1994	13,194	23,565	25,811	165
1995	15,772	21,780	23,332	168
1996	15,431	22,999	24,122	172
1997	17,360	23,420	24,005	176
1998	**18,763**	**20,687**	**20,687**	**180**
Average	12,885	19,582	22,277	
Standard Deviation	6,086	9,779	10,329	

Data: Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports.

Data Source: P8798N.cal (4/22/99)

Figure 8. Species composition of Hawaii commercial billfish catch, 1987 - present.





Species composition of Hawaii commercial billfish catch, 1987 - present

Year	Pounds Landed (x 1,000)			
	Blue Marlin	Striped Marlin	Swordfish	Other Billfish
1987	671	669	59	244
1988	784	1,220	65	244
1989	1,527	1,353	616	349
1990	1,439	1,361	3,411	138
1991	1,465	1,590	10,113	454
1992	1,378	1,085	12,644	318
1993	1,391	1,193	13,126	267
1994	1,461	798	7,008	271
1995	1,979	1,316	6,023	474
1996	1,914	1,039	5,532	300
1997	1,897	861	6,367	354
1998	**1,297**	**876**	**7,202**	**424**
Average	1,434	1,113	6,014	320
Standard Deviation	402	274	4,481	98

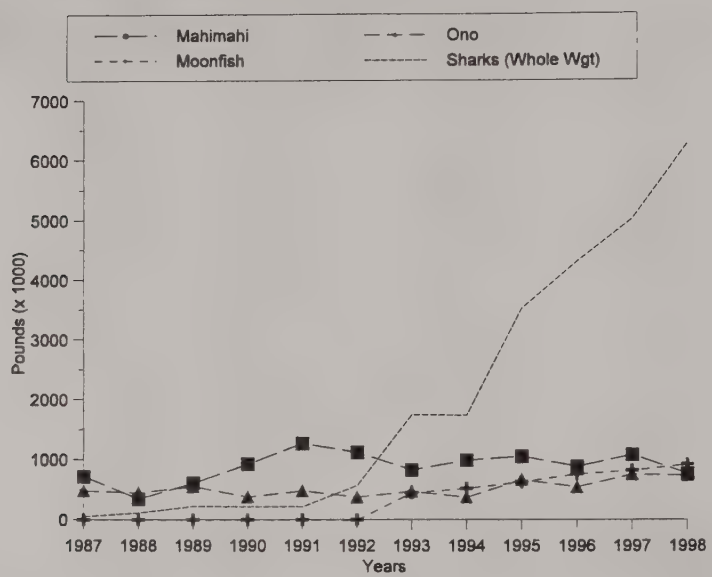
Interpretation: The swordfish component of the longline fishery rose rapidly in the early 1990s, with a significant decline subsequently as longline fishing effort shifted towards tuna. Blue marlin landings were above the long-term average. Other species were within their recent ranges.

Longline landings of blue marlin have increased from 15% of the total in 1987 to 66% in 1998. Troll-handline-other landings have remained relatively constant over the time period, although 1998 was a poor year for most species.

Data: Species summaries for all gears combined are compiled from HDAR and NMFS landings figures. Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports. Data are rounded to the nearest 100,000 pounds.

Data Source: P8798N.xls (4/22/99)

Figure 9. Hawaii commercial catch -- mahimahi, ono (wahoo), mooonfish (opah), and sharks (whole weight), 1987 - present



Interpretation: Mahimahi landings are within their recent ranges while ono (wahoo) landings were the highest in recent years. In 1998, 99,700 sharks were caught by the Hawaii-based domestic longline fishery, of which 60,800 were kept (61%): only 726 sharks were kept as *whole* shark product and the remainder were processed as a finned product (shark landings are reported as biomass (whole or round weight) figures).

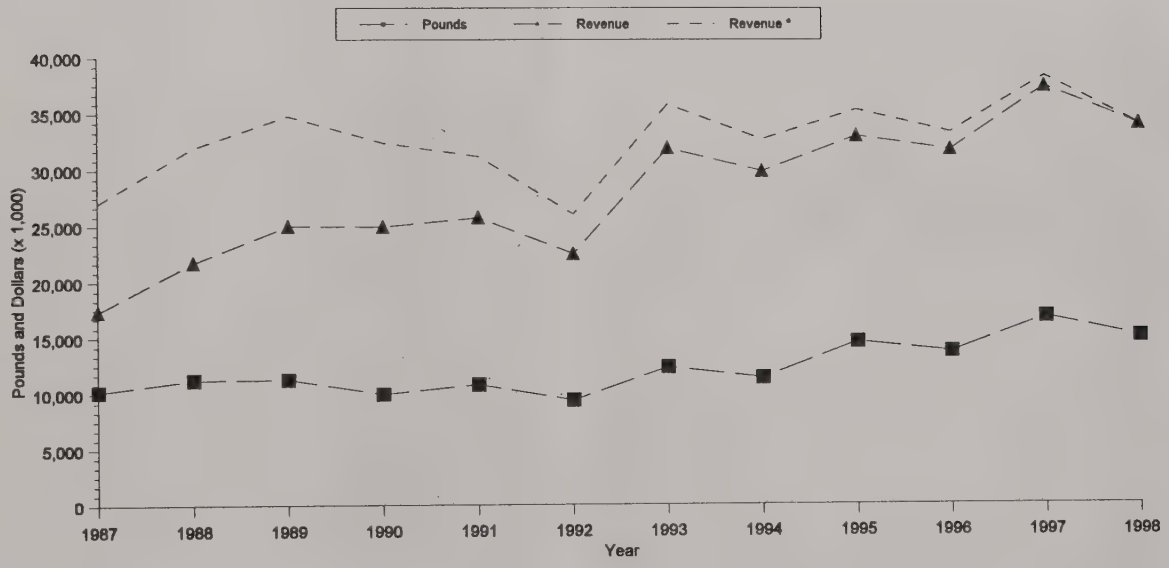
Hawaii commercial catch -- mahimahi, ono(wahoo), and sharks.

Year	Pounds (x 1,000) Mahimahi	Ono	Moonfish	Sharks (Whole Wgt)
1987	722	484	0	57
1988	345	452	0	118
1989	612	553	0	224
1990	927	381	0	221
1991	1,271	482	0	222
1992	1,120	380	0	573
1993	830	473	450	1,748
1994	993	377	520	1,738
1995	1,055	669	630	3,518
1996	888	548	760	4,311
1997	1,085	757	823	5,019
1998	**772**	**741**	**922**	**6,269**
Average	885	525	342	2,002
Standard Deviation	251	134	378	2,215

Data: Species summaries for all gears combined are compiled from HDAR and NMFS landings figures. Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports. Data are rounded to the nearest 100,000 pounds. Shark landings represent reported weights for troll-handline-other gears and NMFS estimates of round or whole weights for longline-caught shark, including sharks "finned" (where only the fins are retained and the carcasses are discarded at sea).

Data Source: P8798N.cal (4/22/99)

Figure 10. Hawaii tuna catch and revenue, 1987 - present.



Interpretation: Tuna landings in the Hawaii commercial fishery have been near record levels (1965 being the highest year of the aku boat fishery) and the highest since the tuna cannery closed (1984).[18] Nominal and inflation-adjusted ex vessel revenue are also at record levels, although somewhat lower in 1998 than 1997 due to weakness in both the sashimi and albacore markets. Troll-handline-other landings of tuna are below average for the recent period. Aku boat (pole-and-line skipjack tuna) landings remain depressed despite new investment in that sector.

Hawaii tuna catch and revenue, 1987 - present

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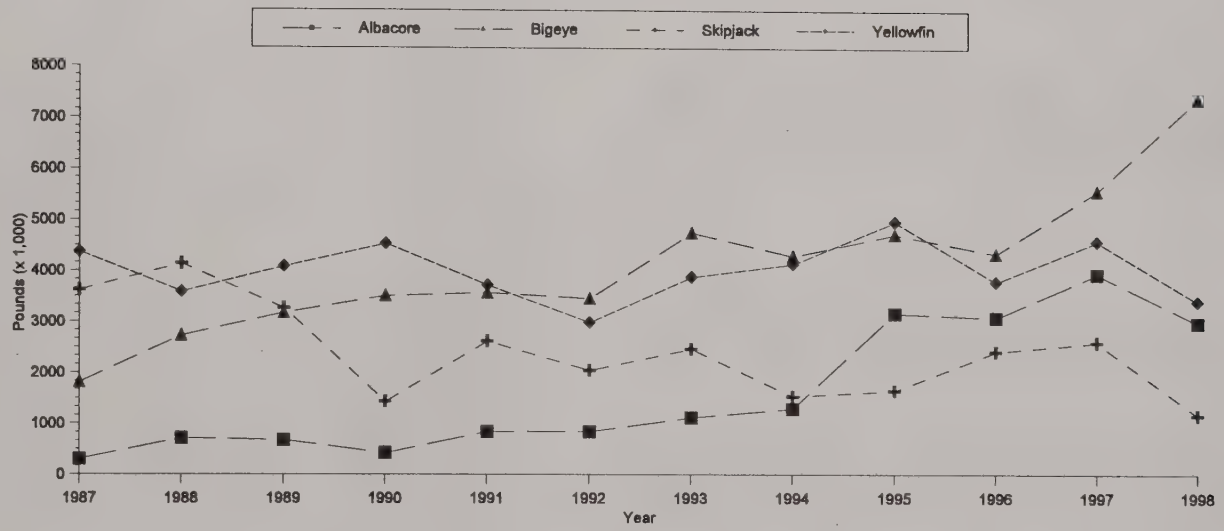
[18] Total tuna landings were 14,700,000 pounds (sold) in 1970, of which over half was from the pole-and-line aku boat fleet. The record landings were in 1965 (16.3 million pounds).

Year	Pounds Landed (x 1,000)	Nominal Revenue x $1,000	Inflation-adjusted Revenue x $1,000	HCPI
1987	10,211	17,390	27,068	116
1988	11,274	21,780	31,996	123
1989	11,312	25,032	34,817	130
1990	10,005	24,984	32,449	139
1991	10,843	25,776	31,229	149
1992	9,428	22,528	26,068	156
1993	12,371	31,924	35,838	161
1994	11,382	29,857	32,703	165
1995	14,609	33,001	35,353	168
1996	13,724	31,804	33,357	172
1997	16,834	37,460	38,396	176
1998	**15,078**	**34,124**	**34,124**	**180**
Average	12,256	27,972	32,783	
Standard Deviation	2,306	5,949	3,498	

Data: Commercial landings and ex vessel revenue for all gears combined are compiled from HDAR and NMFS figures. Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports. Data are rounded to the nearest 100,000 pounds. Inflation-adjusted revenue bases previous year's revenues on the current year (1997) Honolulu consumer price index (HCPI).

Data Source: P8798n.xls (4/22/99)

Figure 11. Species composition of Hawaii commercial tuna catch, 1987 - present.



Interpretation: Bigeye landings were at record landings in 1998 while albacore landings remain high. Longline landings of albacore have increased dramatically over the past four years. Yellowfin landings was below its recent average with landings from all gear types down from 1996. Skipjack tuna (aku) landings were the lowest on record.

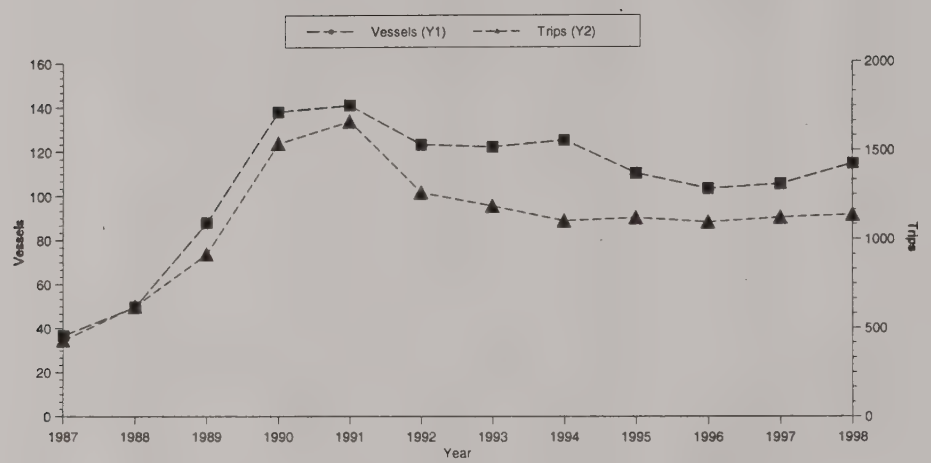
Species composition of Hawaii commercial tuna catch, 1987 - present.

Year	Pounds Landed (x 1,000)			
	Albacore	Bigeye	Skipjack (aku)	Yellowfin
1987	313	1,819	3,628	4,376
1988	720	2,737	4,147	3,594
1989	679	3,186	3,276	4,094
1990	429	3,519	1,438	4,540
1991	849	3,579	2,625	3,729
1992	851	3,464	2,051	2,994
1993	1,128	4,758	2,473	3,892
1994	1,297	4,301	1,540	4,144
1995	3,174	4,729	1,651	4,975
1996	3,092	4,348	2,423	3,798
1997	3,956	5,602	2,609	4,598
1998	**3,003**	**7,429**	**1,175**	**3,421**
Average	1,624	4,123	2,420	4,013
Standard Deviation	1,290	1,451	918	557

Data: Species summaries for all gears combined are compiled from HDAR and NMFS landings figures. Longline data are compiled from NMFS estimates. Troll-handline-other pelagics data are compiled from HDAR commercial catch reports. Data are rounded to the nearest 100,000 pounds.

Data Source: P8798N.xls (4/22/99)

Figure 12. Hawaii longline vessel activity, 1987 - present.



Interpretation: Longline vessel activity in Hawaii has increased in 1998 as a number of vessels returned from the mainland U.S. although activity remains substantially below the 1990-91 peak when limited entry into the fishery was introduced.

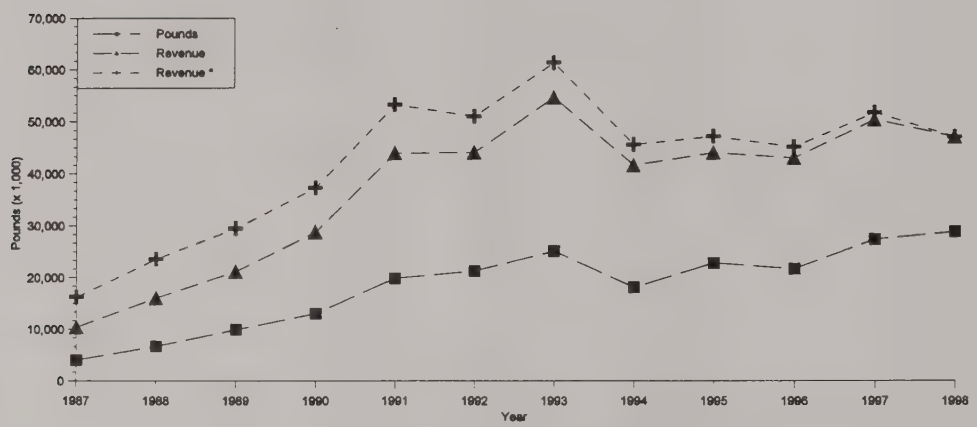
Hawaii longline vessel activity, 1987 - present.

Year	Active Vessels	Trips
1987	37	435
1988	50	627
1989	88	923
1990	138	1,546
1991	141	1,671
1992	123	1,266
1993	122	1,192
1994	125	1,106
1995	110	1,125
1996	103	1,100
1997	105	1,125
1998	**114**	**1,139**
Average	105	1,105
Standard Deviation	31	324

Data: Longline fishing effort data are compiled from Federal logbooks collected by the Fishery Monitoring & Economics Program of the NMFS Honolulu Laboratory for the year 1991-present, and by shoreside monitoring by FMEP in earlier years (Ito, 1997).

Data source: (LL98.xls RYI, 4/2/99)

Figure 13a. Hawaii longline catch and revenue, 1987 - present.



Interpretation: Hawaii longline landings grew substantially in 1997 and 1998 to a new peak after having been stable for the previous several years. Most of the effort in the past several years has been directed at tunas, with bigeye and albacore providing the largest volume. Swordfish remains the largest single component, but only marginally more than bigeye tuna. However bigeye tuna provides almost twice the ex-vessel revenue as swordfish. Albacore tuna declined substantially in 1998 as prices were especially weak.

Hawaii longline catch and revenue, 1987 - present.

Year	Pounds (x 1,000)	Nominal Revenue ($1,000)	Adjusted Revenue ($1,000)	Honolulu Consumer Price Index
1987	4,100	10,450	16,266	116
1988	6,750	16,050	23,578	123
1989	9,950	21,150	29,418	130
1990	13,050	28,650	37,210	139
1991	19,750	43,820	53,090	149
1992	21,130	43,880	50,776	156
1993	24,930	54,380	61,046	161
1994	17,990	41,370	45,314	165
1995	22,660	43,780	46,900	168
1996	21,520	42,750	44,838	172
1997	27,116	50,043	51,294	176
1998	**28,575**	**46,651**	**46,651**	**180**
Average	18,127	36,915	42,198	
Standard Deviation	7,970	14,213	13,130	

Data: Longline landings and ex vessel revenue estimates are compiled by the NMFS Honolulu Laboratory. They represent weight estimates using Federal logbooks (since 1991) and market monitoring average weight per fish and average price per pound. From 1987-1990, estimates rely on NMFS shoreside and market monitoring.

Data Source: P8798N.xls (4/22/99)

Figure 13b. Hawaii longline landings -- billfish (including swordfish), 1987 -present.

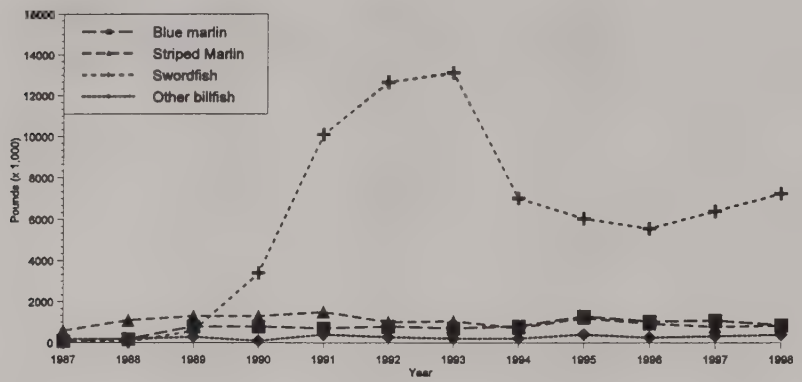
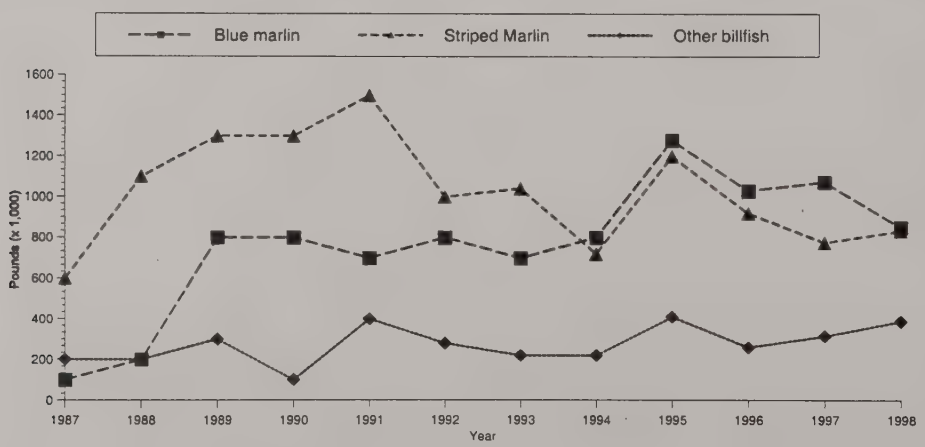


Figure 13c. Hawaii longline catch – marlins & other billfish, 1987 - present.



Hawaii longline catch -- billfish (including swordfish), 1987 - present.

	Pounds Caught (x 1,000)			
	Blue marlin	**Striped marlin**	**Swordfish**	**Other billfish**
1987	100	600	50	200
1988	200	1,100	50	200
1989	800	1,300	600	300
1990	800	1,300	3,400	100
1991	700	1,500	10,100	400
1992	800	1,000	12,640	280
1993	700	1,040	13,100	220
1994	800	720	7,000	220
1995	1,280	1,200	6,010	410
1996	1,030	920	5,520	260
1997	1,074	775	6,351	316
1998	**851**	**833**	**7,189**	**389**
Average	761	1,024	6,001	275
Std Deviation	332	269	4,480	94

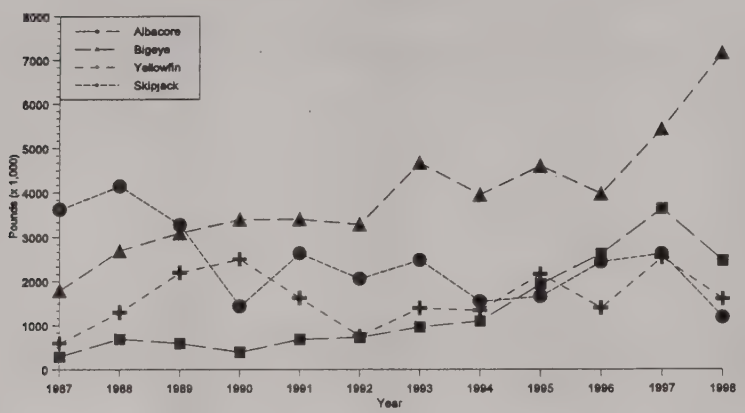
Data: Data are compiled from Federal logbooks and market monitoring information by NMFS Honolulu Laboratory and HDAR staff.

Data source: P8798N.xls (4/22/99)

Interpretation: Total billfish catch (including swordfish) have been relatively stable the last few years. However catch of striped marlin has declined in the past three years to below its 10-year average. The dramatic decline in swordfish catch in 1994 represented a change in vessel targeting practices.[19] A subsequent figures shows the decline in swordfish-directed trips and the stability in accompanying catch per unit effort (CPUE). Nonetheless, swordfish remains the largest single species caught by the Hawaii longline fleet in terms of pounds caught, although the ex vessel revenue of bigeye tuna exceeds swordfish revenue. Most swordfish continues to be exported to the U.S. mainland. All other species are within their recent ranges and above their long-term averages. Swordfish catch was worth $12 million ex-vessel, while the other marlins were $2.4 million.

[19] See the 1995 annual report for a full discussion of the 1994 swordfish CPUE.

Figure 14. Hawaii longline catch -- tunas, 1987 - present.



Interpretation: All tuna species except for yellowfin show increasing catch over the past five years as targeting towards tunas has returned to historical patterns. Yellowfin tunas shows more inter-annual variation than other species and is not significantly below its recent average. Bigeye catch was at a record level, while albacore has shown the largest increase over the past five years, evidently reflecting its increased availability or catchability. Some longline trips now target albacore (despite its relatively low price per pound). Longline tuna landings were $28 million ex vessel.

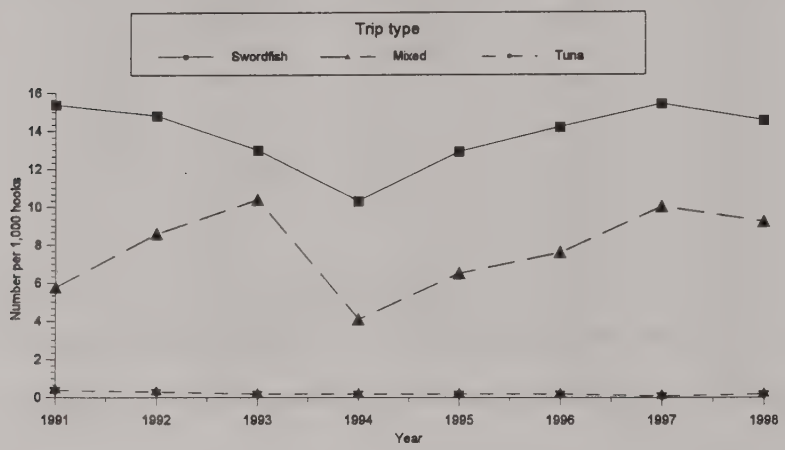
Hawaii longline catch -- tunas, 1987 - present.

	Pounds Caught (x 1,000)				
Year	Albacore	Bigeye	Yellowfin	Skipjack	Bluefin
1987	300	1,800	600	3,628	0
1988	700	2,700	1300	4,147	0
1989	600	3,100	2200	3,276	0
1990	400	3,400	2500	1,438	0
1991	690	3,400	1620	2,625	0
1992	730	3,280	760	2,051	0
1993	970	4,660	1390	2,473	0
1994	1,100	3,940	1340	1,540	30
1995	1,930	4,580	2150	1,651	60
1996	2,610	3,950	1390	2,423	50
1997	3,619	5,399	2515	2,609	52
1998	**2,449**	**7,100**	**1587**	**1,175**	**36**
Average	1,436	4,137	1,705	2,420	19
Std. Dev.	1,057	1,378	622	918	25

Data: Data are compiled from Federal logbooks and market monitoring information by NMFS Honolulu Laboratory and HDAR staff. Bluefin tuna not recorded on chart due to small magnitudes.

Source:P8798N.xls (4/22/99)

Figure 15. Hawaii longline catch rates -- swordfish catch by trip type, 1991 - present.



Interpretation: Although *aggregate* swordfish CPUE has fallen consistently since 1993, this graph makes clear that there is a tremendous difference between aggregate CPUE (which does not take into account targeting), and trip-type CPUE.

Swordfish CPUE on trips which target swordfish declined from 1992 (the year after the Federal logbook program was initiated and shortly after the inception of the swordfish fishery in Hawaii), dipping dramatically in 1994. Swordfish CPUE has since recovered to its initial levels, although the amount of fishing effort is dramatically lower.

Mixed trip CPUE showed a much steeper decline in 1994, but a similar recovery. This may reflect changes in Mixed trip targeting behavior from techniques which would catch more swordfish to techniques which would catch more tuna.

The 1995 annual report contained an analysis of these trends.

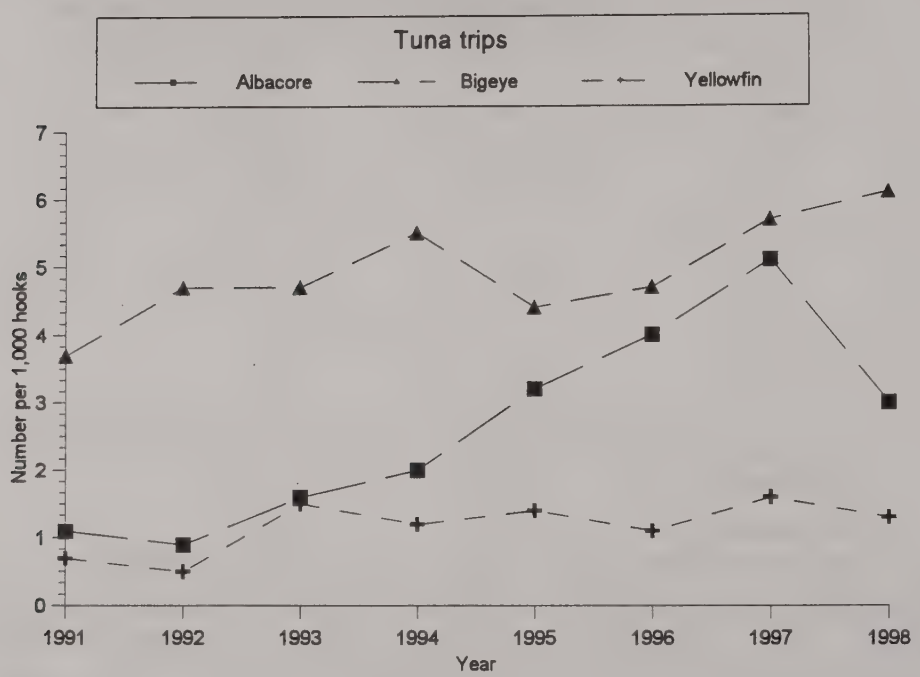
Swordfish CPUE by longline trip type, 1987 - present

Year	Swordfish CPUE (number caught per 1,000 hooks)		
	Swordfish trips	Mixed trips	Tuna trips
1991	15.4	5.8	0.4
1992	14.8	8.6	0.3
1993	13.0	10.4	0.2
1994	10.3	4.1	0.2
1995	12.9	6.5	0.2
1996	14.2	7.6	0.2
1997	15.4	10.0	0.1
1998	**14.5**	**9.2**	**0.2**
Average	13.8	7.8	0.2
Std. Deviation	1.7	2.2	0.1

Data: Longline catch rates are compiled from Federal logbooks. CPUE is *Number caught* per 1,000 hooks set. Trips are categorized by longline captains (or by NMFS staff in the absence of a longline captain) as targeting Swordfish, Tuna or Mixed (meaning either switching of target during the trip or the absence of an explicit target).

Data source: LL96trip.cal (4/22/97) updated by Ito, 1998 preliminary data. There were some revisions in the historical cpue data to correct the calculation for zero catch sets. (The same applies to the following cpue's.)

Figure 16. Hawaii longline catch rates -- major tuna species by tuna trips, 1991 - present.



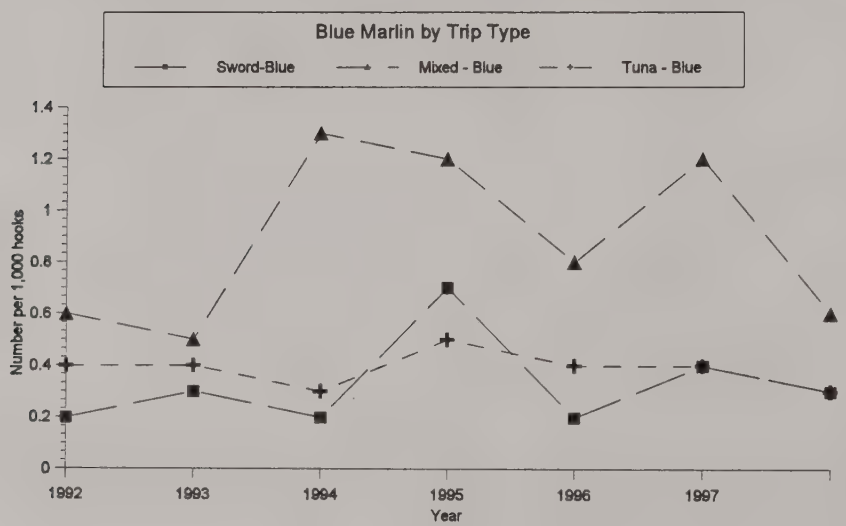
Interpretation: Tuna-trips provide the most realistic view of tuna species catch rates (CPUEs). Albacore is probably more targeted in 1996 and 1997 than previous years, but it appears to be more abundant as well. Tuna-directed trip catch rates for albacore in 1998 fell. Bigeye catch rates have risen substantially in the past two years. Yellowfin tuna is within its recent norm.

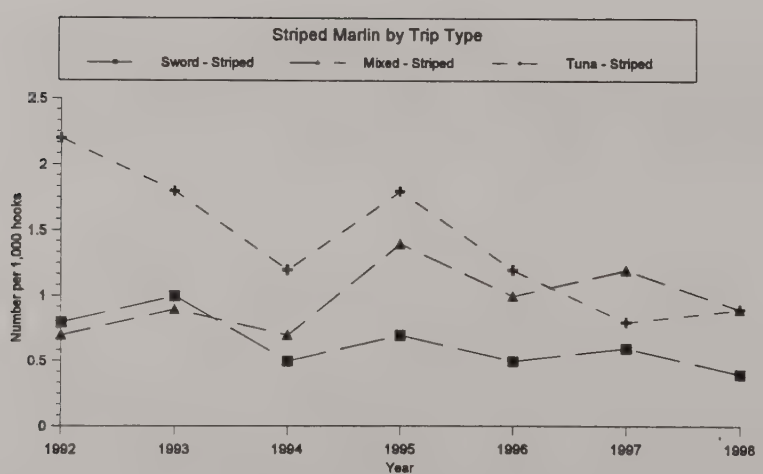
Year	Tuna-trip CPUEs (number caught per 1,000 hooks)		
	Albacore	Bigeye	Yellowfin
1991	1.1	3.7	0.7
1992	0.9	4.7	0.5
1993	1.6	4.7	1.5
1994	2.0	5.5	1.2
1995	3.2	4.4	1.4
1996	4.0	4.7	1.1
1997	5.1	5.7	1.6
1998	**3.0**	**6.1**	**1.3**
Average	2.6	4.9	1.2
Std. Deviation	1.5	0.8	0.4

Data: Longline catch rates are compiled from Federal logbooks. CPUE is *Number caught* per 1,000 hooks set. Trips are categorized by longline captains (or by NMFS staff in the absence of a longline captain) as targeting Swordfish, Tuna or Mixed (meaning either switching of target during the trip or the absence of an explicit target).

Data source: LL96trip.cal (4/22/97) updated by Ito, 1998 using preliminary data.

Figure 17. Hawaii longline catch rates -- blue & striped marlin by trip type, 1991 - present.





Marlin CPUEs
(number caught per 1,000 hooks)

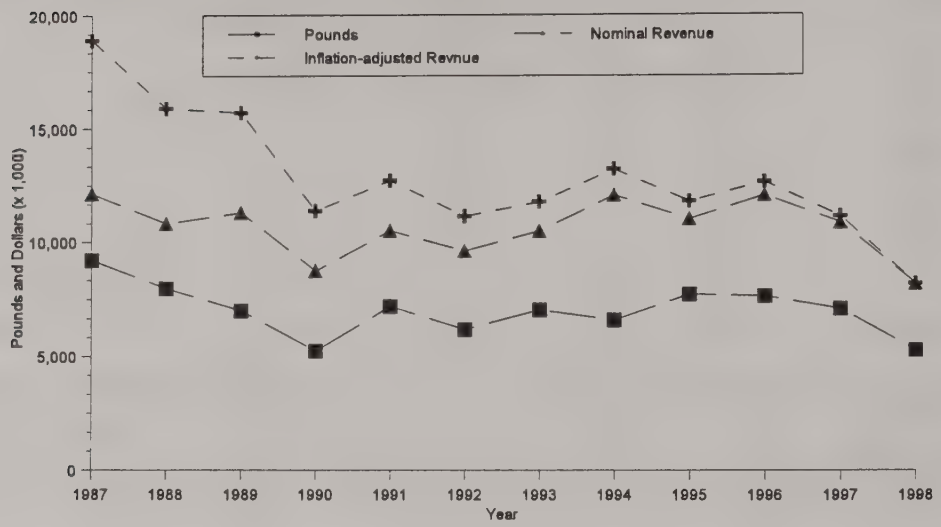
Year	Blue Marlin			Striped Marlin		
	Swordfish Trips	Mixed Trips	Tuna Trips	Swordfish Trips	Mixed Trips	Tuna Trips
1991	poor species identification precluded quantification in 1991					
1992	0.2	0.6	0.4	0.8	0.7	2.2
1993	0.3	0.5	0.4	1.0	0.9	1.8
1994	0.2	1.3	0.3	0.5	0.7	1.2
1995	0.7	1.2	0.5	0.7	1.4	1.8
1996	0.2	0.8	0.4	0.5	1.0	1.2
1997	0.4	1.2	0.4	0.6	1.2	0.8
1998	**0.3**	**0.6**	**0.3**	**0.4**	**0.9**	**0.9**
Average	0.3	0.9	0.4	0.6	1.0	1.4
Std. Deviation	0.2	0.3	0.1	0.2	0.3	0.5

Interpretation: Blue and striped marlin are caught on all three trip types but in different proportions. With the average longline trip setting roughly 1,000 hooks, these catch rates translate into approximately 1 blue marlin and 1 striped marlin per day. Both blue marlin and striped marlin catch rates in 1998 were below average for all three trip types. The blue marlin do not appear to show any trend, but the striped marlin appear to show a declining trend.

Data: Longline catch rates are compiled from Federal logbooks. CPUE is *Number caught* per 1,000 hooks set. Trips are categorized by longline captains (or by NMFS staff in the absence of a longline captain) as targeting Swordfish, Tuna or Mixed (meaning either switching of target during the trip or the absence of an explicit target).

Data source: LL96trip.cal (4/22/97) updated by Ito, 1998 using preliminary data.

Figure 18. Hawaii troll, handline, aku boats and other gear types – catch and revenue (all pelagic species), 1987 - present.



Interpretation: Catch and revenue were both lower for 1997 and even lower in 1998 for the combined troll-handline-other pelagic gears fishery, including pelagics caught by miscellaneous other gears (including distant-water albacore trollers off-loading in Honolulu in some years). The detailed data (shown in subsequent figures) show that MHI troll and MHI handline were particularly lower in 1998. Both nominal and inflation-adjusted ex-vessel revenue were the lowest over the time period.

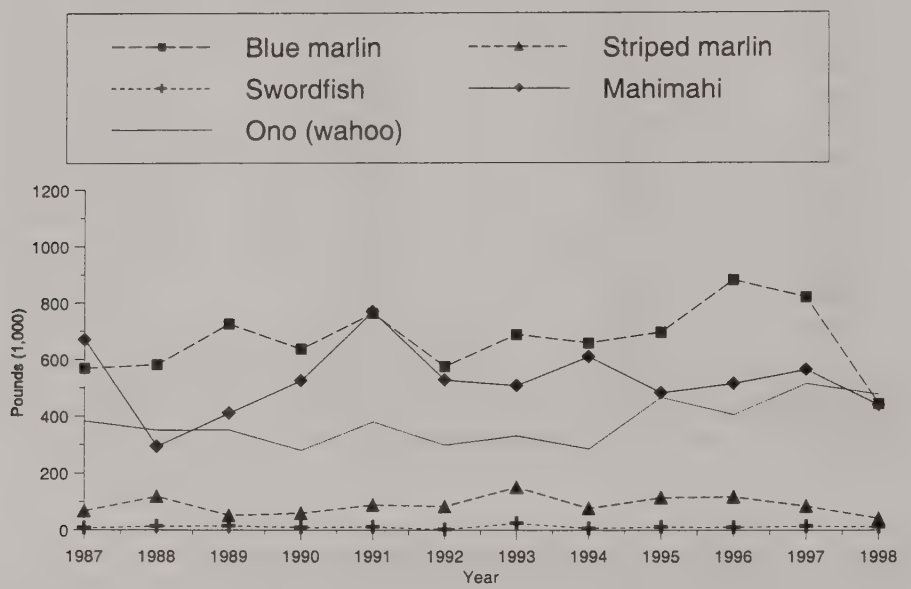
Hawaii troll, handline, aku boats and other gear types – catch and revenue (all pelagic species)

Year	Pounds (x 1,000)	Nominal Revenue ($1,000)	Adjusted Revenue ($1,000)	HCPI
1987	9,237	12,147	18,907	115.9
1988	7,983	10,823	15,900	122.8
1989	7,010	11,292	15,706	129.7
1990	5,241	8,749	11,363	138.9
1991	7,198	10,486	12,704	148.9
1992	6,176	9,603	11,112	155.9
1993	7,035	10,473	11,757	160.7
1994	6,586	12,052	13,201	164.7
1995	7,721	11,001	11,785	168.4
1996	7,635	12,053	12,634	172.1
1997	7,078	10,836	11,107	176.0
1998	**5,266**	**8,159**	**8,159**	**180.4**
Average	7,014	10,639	12,861	
Std. Deviation	1,124	1,270	2,811	

Data: Data are compiled from HDAR commercial catch reports.

Data source: P8798N.xls (4/22/99)

Figure 19.Hawaii commercial troll, handline, aku boats and other gear catch -- non-tuna PMUS, 1987 - present.



Interpretation: Catch for all non-tuna species in the troll-handline-other pelagic gears fisheries dipped substantially in 1998 although ono (wahoo) remains above its long-term average. Information on fishing effort and CPUE is necessary for further interpretation.

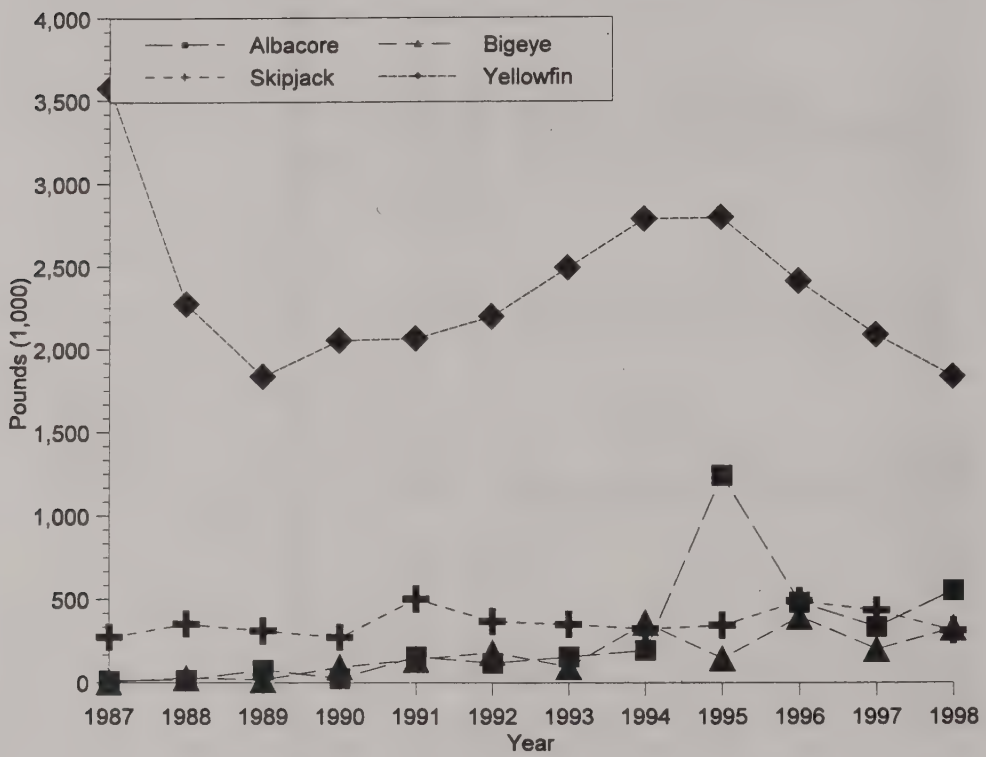
Hawaii commercial troll, handline, aku boats and other gear catch -- non-tuna PMUS

	Pounds Caught (x 1,000)						
Year	**Blue marlin**	**Striped**	**Swordfish**	**Other Billfish**	**Mahimahi**	**Ono(wahoo)**	**Sharks**
1987	571	69	9	44	672	384	7
1988	584	120	15	44	295	352	18
1989	727	53	16	49	412	353	24
1990	639	61	11	38	527	281	21
1991	765	90	13	54	771	382	22
1992	578	85	4	38	530	300	13
1993	691	153	26	47	510	333	18
1994	661	78	8	51	613	287	28
1995	699	116	13	64	485	469	28
1996	884	119	12	40	518	408	11
1997	823	86	16	38	567	518	11
1998	**446**	**43**	**13**	**35**	**441**	**479**	**62**
Average	672	89	13	45	528	379	22
Std. Dev.	120	32	5	8	123	78	14

Data: Data compiled by NMFS staff from HDAR commercial catch reports (pounds caught). Sharks, swordfish and other billfish are not on chart due to low magnitude.

Data source: P8798N.xls (4/22/99)

Figure 20. Hawaii commercial troll, handline, aku boats and other pelagic gears catch -- tunas, 1987 - present.



Interpretation: Catch of the traditional tuna species are within their recent ranges for the combined troll-handline-other pelagic gears fishery, although yellowfin was lower than it had been for some time. Distant-water albacore catch were not recorded in the amounts experienced in 1995, but albacore has become a more important species for both troll, handline, and longline gears.

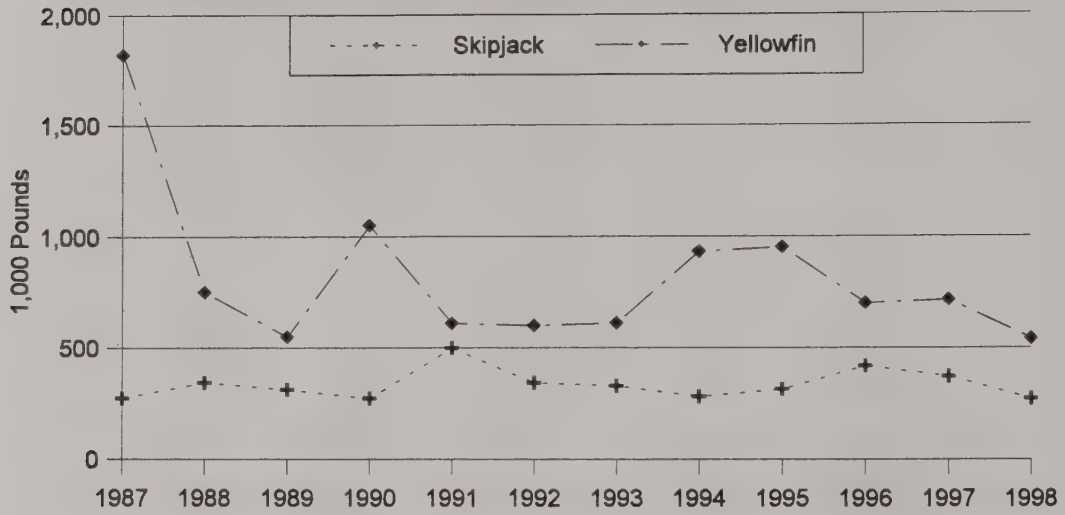
Hawaii commercial troll, handline, aku boats and other pelagic gears catch

Year	Pounds Caught (x 1,000)			
	Albacore	Bigeye	Skipjack	Yellowfin
1987	13	6	275	3,575
1988	20	31	355	2,275
1989	79	19	313	1,837
1990	29	97	275	2,054
1991	159	142	504	2,066
1992	120	184	369	2,198
1993	158	98	352	2,492
1994	197	361	326	2,783
1995	1,244	149	345	2,791
1996	482	398	492	2,406
1997	337	203	433	2,083
1998	**554**	**329**	**313**	**1,832**
Average	283	168	363	2,366
Standard Deviation	351	133	76	496

Data: Data compiled by NMFS staff from HDAR commercial catch reports (1997 data were extrapolated from preliminary reports).

Data source: P8798N.xls (4/22/99)

Figure 21. Main Hawaiian Islands troll catch – major species, 1987 - present.



Interpretation: Skipjack and yellowfin are the primary tuna species caught by trolling vessels. Skipjack catch was below average in 1998 but not significantly lower, while yellowfin catch has been below average for the last three years. The albacore "spike" in 1994 was probably distant-water albacore trollers with mis-identified location of catch (i.e., it should have been included in Other).

MHI Troll tuna catch, 1987 - present.

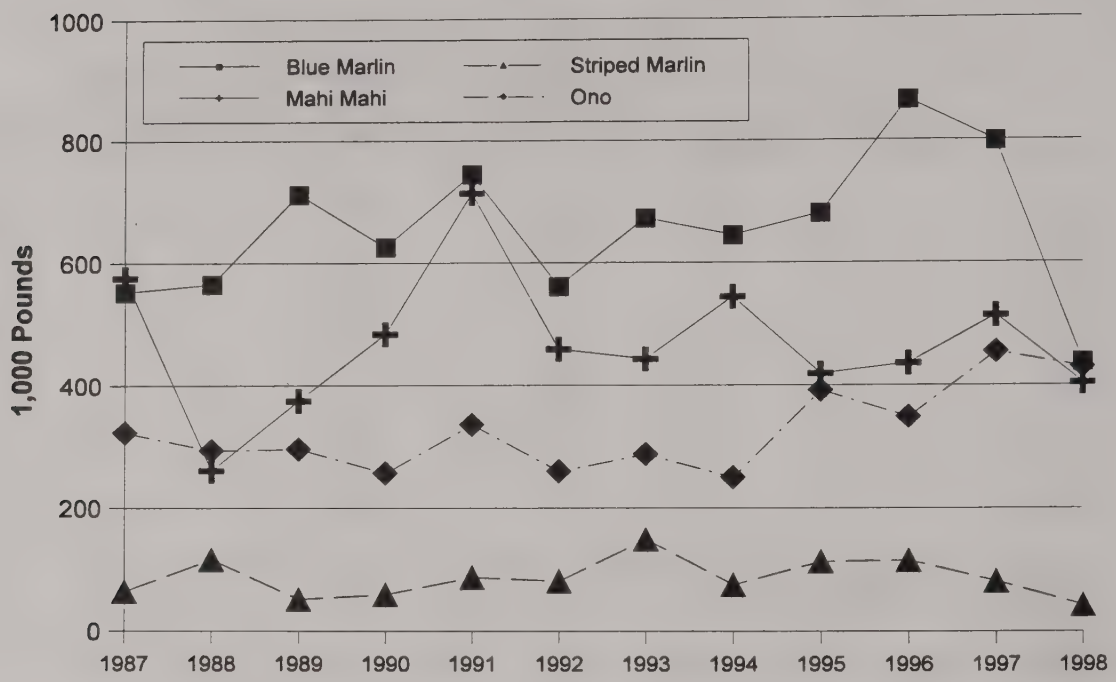
1,000 Pounds caught

	Albacore	Bigeye	Skipjack	Yellowfin	Other Tuna	Total
1987	1	11	275	1,820	19	2,126
1988	1	10	346	752	16	1,124
1989	1	11	314	551	14	891
1990	1	15	274	1,053	18	1,360
1991	2	11	501	612	14	1,139
1992	3	9	344	602	16	974
1993	3	4	331	614	11	963
1994	21	6	283	934	19	1,263
1995	10	10	317	954	11	1,302
1996	5	4	420	702	7	1,138
1997	7	6	374	717	6	1,110
1998	**2**	**5**	**274**	**544**	**9**	**834**
Average	5	8	338	821	13	1,185
Standard Deviation	6	3	68	356	4	338

Data: Data compiled by NMFS staff from HDAR commercial catch reports (data for 1997 are extrapolated from preliminary reports). These data reflect only trolling gear codes and main Hawaiian islands locations. Some off-shore seamounts (e.g., Cross) are excluded, as are distant-water albacore catch. However some off-shore seamounts (e.g., Jagger) are included, based on the HDAR area code determinations (area codes less than 1000).

Data source: P8798N.xls (4/22/99)

Figure 22. MHI Troll Billfish and non-Tuna catch, 1987-present

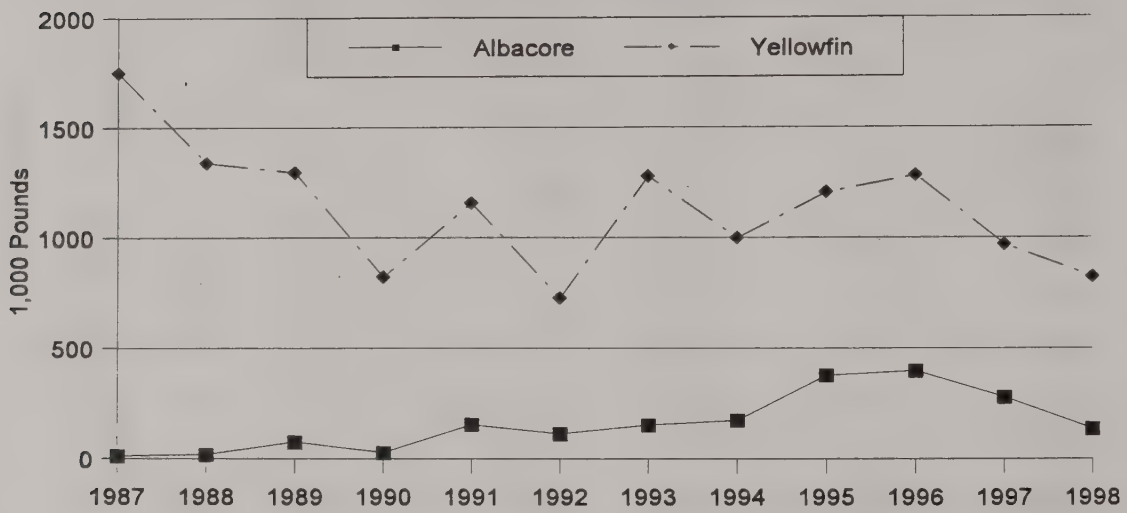


Interpretation: MHI troll catch for non-Tunas has remained fairly steady since being monitored. The exception this year is with blue marlin, which has dropped in half from its high two years ago.

MHI Troll Billfish and non-Tuna catch, 1987-present.

	1,000 Pounds caught				
	Blue Marlin	Striped Marlin	Swordfish	Mahi Mahi	Ono (wahoo)
1987	553	65	1	576	323
1988	566	117	2	261	294
1989	712	52	2	375	296
1990	626	60	1	484	257
1991	745	88	1	714	336
1992	562	82	0	459	260
1993	673	150	0	443	288
1994	645	76	1	545	250
1995	681	114	1	419	392
1996	866	116	1	436	349
1997	799	82	1	514	455
1998	**438**	**43**	**1**	**404**	**430**
Average	656	87	1	469	328
Std.deviation	118	32	1	113	68

Figure 23. Main Hawaiian Islands handline catch (excluding distant seamounts) -- major species, 1987 - present



Interpretation: MHI handline catch in 1997 and 1998 was down from recent peaks for albacore and yellowfin tuna (the mainstay of the fishery).

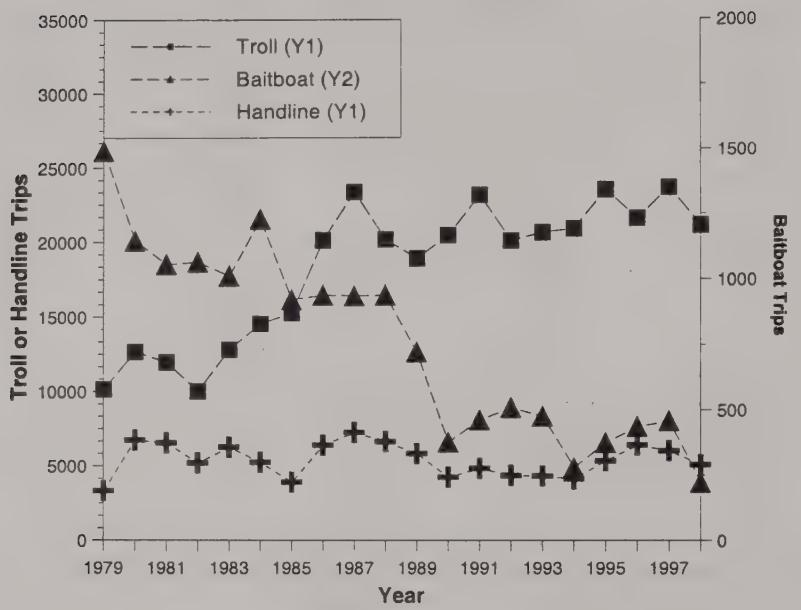
Main Hawaiian Islands handline catch (excluding distant seamounts) -- major species

	MHI Handline 1,000 Pounds Caught					
	Albacore	Bigeye	Skipjack	Yellowfin	Other Tuna	Total Tuna
1987	12	6	25	1,750	5	1,798
1988	19	28	31	1,341	11	1,430
1989	77	19	20	1,297	7	1,420
1990	29	42	26	822	6	925
1991	156	45	19	1,158	9	1,386
1992	115	164	21	728	0	1,028
1993	154	2	13	1,280	0	1,449
1994	175	10	21	999	0	1,205
1995	378	33	17	1,207	0	1,635
1996	399	11	70	1,284	0	1,764
1997	280	52	57	969	0	1,357
1998	**138**	**8**	**30**	**823**	**0**	**998**
Average	161	35	29	1,138	3	1,366
Std. Deviation	131	44	17	287	4	286

Data: Data compiled by NMFS staff from HDAR commercial catch reports (data for 1997 are extrapolated from preliminary reports). These data reflect the various handline gear codes in the State data, for fishing within the main Hawaiian Islands. The more distant off-shore seamounts (e.g., Cross) are excluded. However other off-shore seamounts (e.g., Jagger) are included, based on the HDAR area code determinations (area codes less than 1000).

Data source: P8798N.xls (4/22/99).

Figure 24. Hawaii commercial pelagic trips by non-longline gears

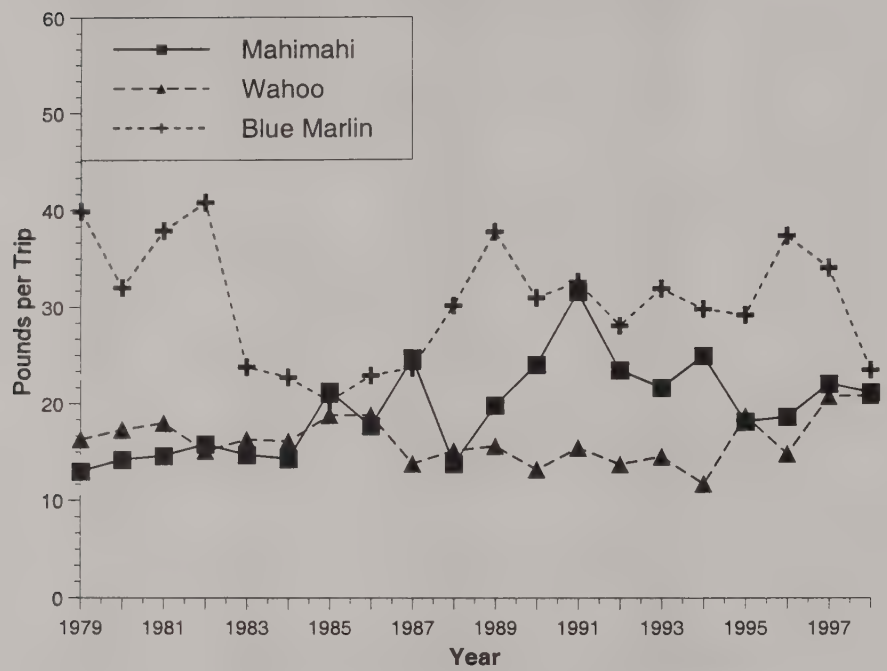


Interpretation: Trips by non-longline pelagic fishing vessels declined in 1998. Commercial trolling activity has continued at a high level between 20,000 and 25,000 trips per year since 1986, despite a small decline in 1996. The pattern continued in 1998. After a low period in the late-1980's to mid-1990's, handline trips were relatively high in 1996 and 1997. Although the number of trips dropped by 16% in 1998, it remained within the long-term average. Baitboat activity was at a record low for the 20 year period shown. Even with the recent success of a new baitboat in the fleet, the rest of the fleet is fading away due to aging and losses of vessels.

	Number of Trips		
Year	**Troll**	**Baitboat**	**Handline**
1979	10,185	1,495	3,346
1980	12,692	1,149	6,746
1981	11,975	1,059	6,562
1982	10,039	1,067	5,219
1983	12,842	1,014	6,275
1984	14,556	1,232	5,248
1985	15,291	924	3,929
1986	20,139	941	6,412
1987	23,391	938	7,263
1988	20,202	941	6,647
1989	18,924	723	5,834
1990	20,468	378	4,261
1991	23,184	463	4,861
1992	20,109	510	4,374
1993	20,647	477	4,343
1994	20,905	281	4,142
1995	23,527	376	5,357
1996	21,611	438	6,416
1997	23,674	459	6,032
1998	**21,112**	**223**	**5,091**
Average	18,274	754	5,418
Standard Deviation	4,650	364	1,111

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Figure 25. Commercial trolling catch per trip -- mahimahi, wahoo and blue marlin

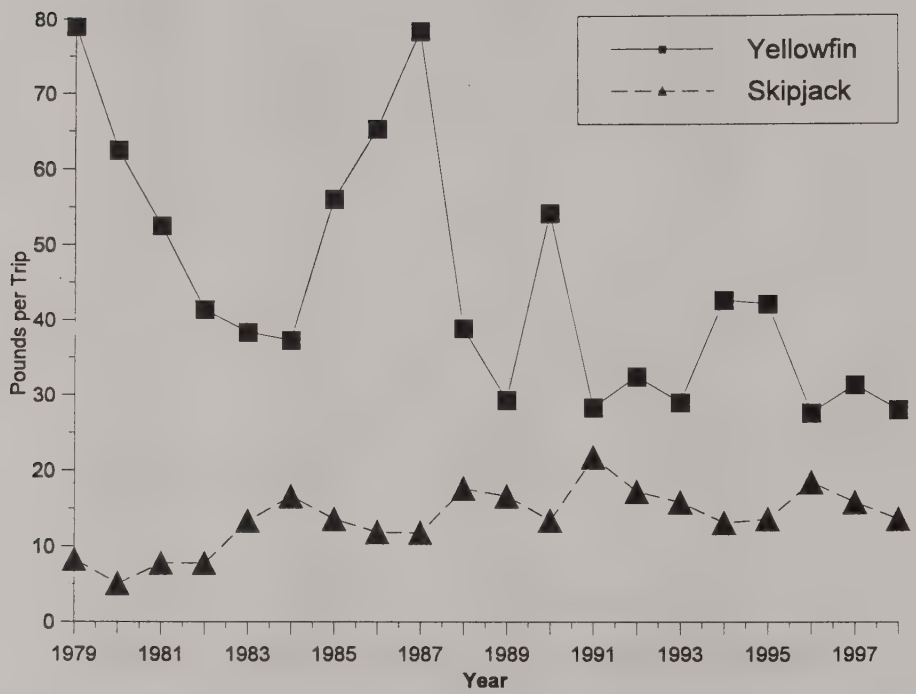


Interpretation: The troll catch rates for non-tuna species were somewhat variable. The mahimahi catch rate was about the same and was within the long-term average catch rate. The wahoo catch rate reached a new peak in 1998 and was above the long-term average. The blue marlin catch rate was the lowest since 1986 but was just below the long-term average. Reported troll mahimahi landings were 446,691 pounds, wahoo 439,990 pounds, and blue marlin 494,045 pounds.

	Pounds Caught per Trolling Trip		
Year	**Mahimahi**	**Wahoo (Ono)**	**Blue Marlin**
1979	13.0	16.3	39.9
1980	14.2	17.3	32.0
1981	14.6	18.0	37.9
1982	15.8	15.1	40.8
1983	14.7	16.3	23.8
1984	14.3	16.1	22.7
1985	21.3	18.8	20.3
1986	17.7	18.8	22.9
1987	24.7	13.8	23.7
1988	13.8	15.1	30.1
1989	19.8	15.6	37.7
1990	24.0	13.2	30.9
1991	31.5	15.4	32.5
1992	23.4	13.7	28.0
1993	21.6	14.5	31.8
1994	24.9	11.7	29.7
1995	18.1	18.7	29.1
1996	18.6	14.8	37.2
1997	22.0	20.7	33.9
1998	**21.1**	**20.8**	**23.4**
Average	19.5	16.2	30.4
Standard Deviation	4.9	2.5	6.2

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Figure 25a. Commercial trolling catch per trip -- yellowfin & skipjack tuna

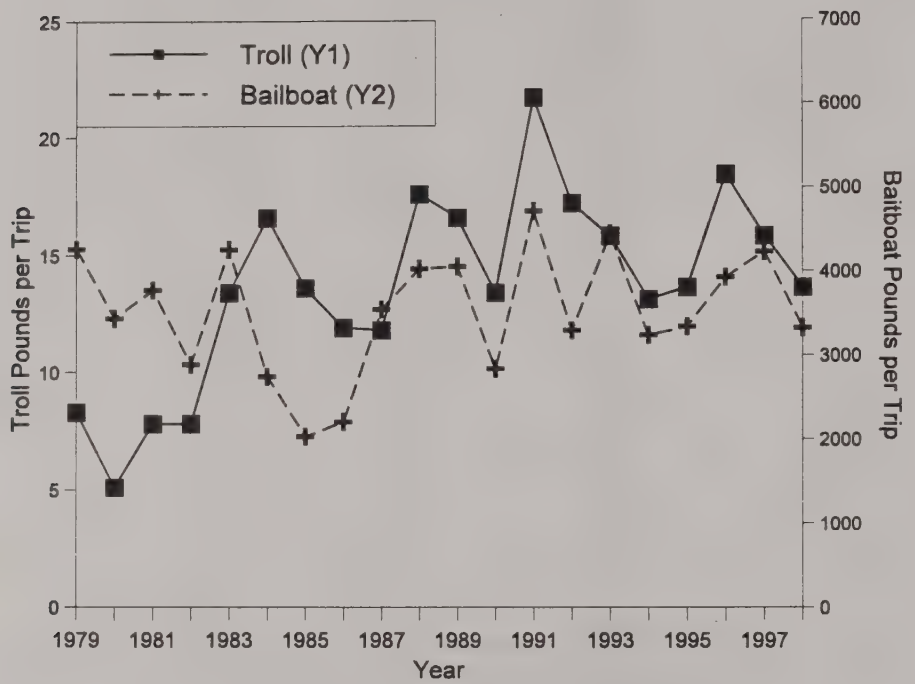


Interpretation: Both yellowfin and skipjack tuna trolling catch rates dropped in 1998. The troll yellowfin tuna catch rate was slightly higher than the record low in 1996, and was below the long-term average. The skipjack catch rate declined from the recent high in 1996 and was right on the long-term average. Reported troll landings were 590,182 pounds for yellowfin and 286,505 pounds for skipjack.

	Pounds per Trolling Trip	
Year	**Yellowfin**	**Skipjack**
1979	79.0	8.3
1980	62.5	5.1
1981	52.5	7.8
1982	41.3	7.8
1983	38.3	13.4
1984	37.2	16.6
1985	55.9	13.6
1986	65.1	11.9
1987	78.1	11.8
1988	38.7	17.6
1989	29.2	16.6
1990	53.9	13.4
1991	28.2	21.7
1992	32.3	17.2
1993	28.9	15.8
1994	42.4	13.1
1995	41.9	13.6
1996	27.5	18.4
1997	31.2	15.8
1998	**27.9**	**13.6**
Average	44.6	13.7
Standard Deviation	16.0	4.0

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Figure 26. Baitboat & commercial trolling catch per trip -- skipjack tuna

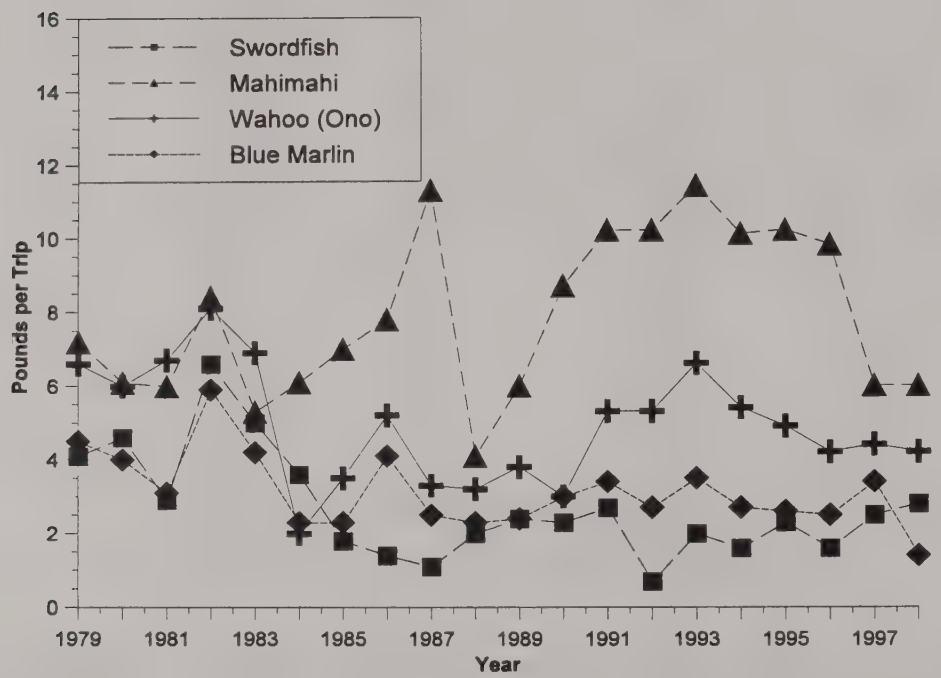


Interpretation: This figure shows the close correspondence of baitboat and trolling catch rates for skipjack once the level of cannery catch declined substantially, beginning in the mid-1980s. The 1998 baitboat catch rate dropped substantially, but was within the long-term average. HDAR reports show the baitboats landing only 741,433 pounds of skipjack tuna in 1998, a drop of 62% from 1997. Part of this can be explained by the much reduced level of effort, less than half that reported in 1997.

	Pounds Skipjack Caught per Trip	
Year	**Trolling**	**Baitboat**
1979	8.3	4,278
1980	5.1	3,447
1981	7.8	3,786
1982	7.8	2,892
1983	13.4	2,468
1984	16.6	2,748
1985	13.6	2,031
1986	11.9	2,206
1987	11.8	3,548
1988	17.6	4,036
1989	16.6	4,061
1990	13.4	2,840
1991	21.7	4,722
1992	17.2	3,297
1993	15.8	4,447
1994	13.1	3,240
1995	13.6	3,341
1996	18.4	3,928
1997	15.8	4,231
1998	**13.6**	**3,325**
Average	13.7	3,444
Standard Deviation	4.1	753

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Figure 27. Combined commercial handline catch per trip -- swordfish, mahimahi, ono (wahoo), & blue marlin

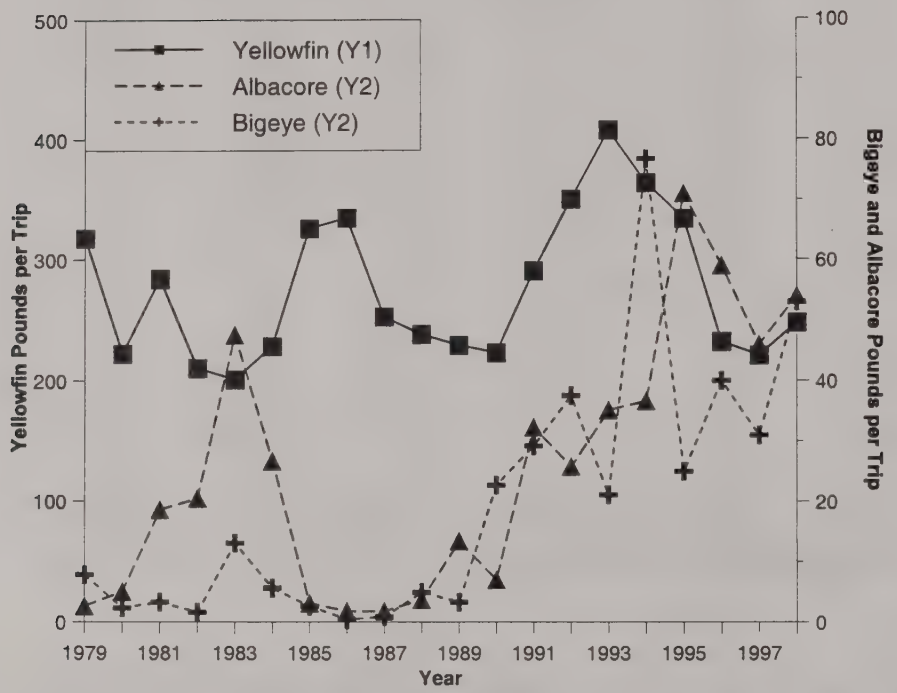


Interpretation: Swordfish and wahoo (ono) catch rates in the handline fishery remained generally within their long-term averages, however, mahimahi and blue marlin catch rates were low. The mahimahi catch rate dropped substantially in both 1997 and 1998. The blue marlin catch rate reached a record low, less than half the rate in 1997. Landings were also lower than 1997. Reported handline swordfish landings were 14,086 pounds, mahimahi 30,744 pounds, wahoo 21,549 pounds, and blue marlin 7,229 pounds. Non-tuna species are usually a minor component of the handline fishery landings.

Year	Swordfish	Mahimahi	Wahoo	Blue marlin
1979	4.1	7.2	6.6	4.5
1980	4.6	6.1	6.0	4.0
1981	2.9	6.0	6.7	3.1
1982	6.6	8.4	8.1	5.9
1983	5.0	5.3	6.9	4.2
1984	3.6	6.1	2.0	2.3
1985	1.8	7.0	3.5	2.3
1986	1.4	7.8	5.2	4.1
1987	1.1	11.3	3.3	2.5
1988	2.0	4.1	3.2	2.3
1989	2.4	6.0	3.8	2.4
1990	2.3	8.7	3.0	3.0
1991	2.7	10.2	5.3	3.4
1992	0.7	10.2	5.3	2.7
1993	2.0	11.4	6.6	3.5
1994	1.6	10.1	5.4	2.7
1995	2.3	10.2	4.9	2.6
1996	1.6	9.8	4.2	2.5
1997	2.5	6.0	4.4	3.4
1998	**2.8**	**6.0**	**4.2**	**1.4**
Average	2.7	7.9	4.9	3.1
Standard Deviation	1.4	2.2	1.6	1.0

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). Data combined from reported ika-shibi, palu-ahi, and drifting handline methods from all areas. 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Figure 28. Combined commercial handline catch per trip -- yellowfin, albacore and bigeye tunas

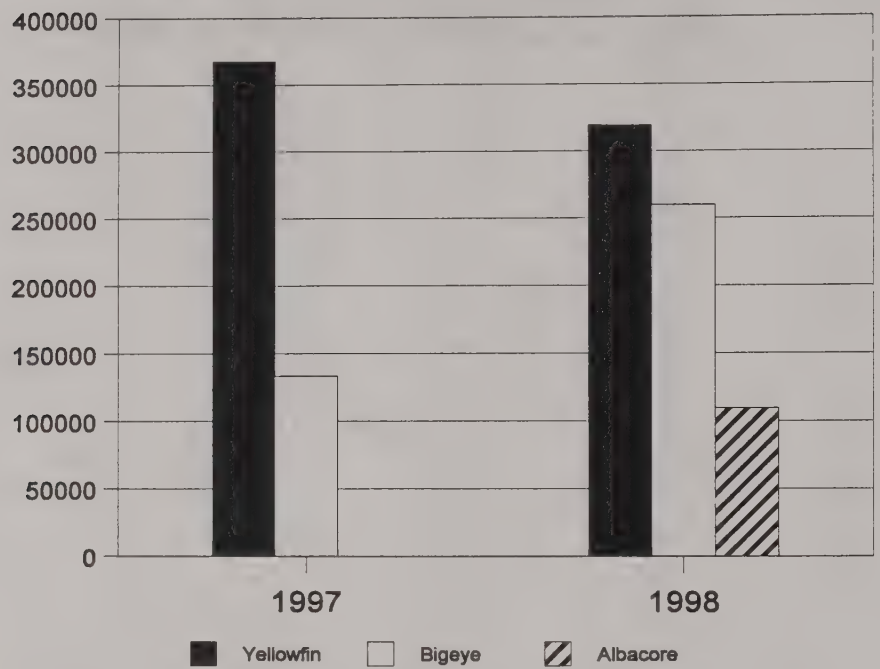


Interpretation: The catch rates for the three tuna species rose significantly from the previous year. The yellowfin tuna catch rate remained within the long-term average, while albacore and bigeye were well above the long-term averages. Reported handline landings were up for all species; 1,263,947 pounds for yellowfin, 274,603 pounds for albacore, and 268,358 pounds for bigeye (more than double 1997 landings). However, the bigeye landings still seem low and may indicate problems in species identification.

Year	Yellowfin	Albacore	Bigeye
1979	318	3	8
1980	222	5	2
1981	285	19	3
1982	211	21	2
1983	201	48	13
1984	229	27	6
1985	326	3	3
1986	335	2	0
1987	253	2	1
1988	238	4	5
1989	229	13	3
1990	223	7	23
1991	291	32	29
1992	350	26	38
1993	408	35	21
1994	364	37	77
1995	334	71	25
1996	232	59	40
1997	221	46	31
1998	**248**	**54**	**53**
Average	276	26	19
Standard Deviation	61	21	21

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). Data combined from reported ika-shibi, palu-ahi, and drifting handline methods from all areas. 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Figure 29. Offshore Tuna Handline Landings and Other Data



Interpretation: Landings of major species from the offshore tuna handline fleet are shown in the graph. The following table also shows the number of trips reported, catch rates, and the percent contribution of offshore handline landings to the total combined handline landings. The handline fleet fishing the offshore seamounts is responsible for most of the reported bigeye landings and significant proportions of the total yellowfin and albacore landings of the combined tuna handline fleet. Their catch rates are also higher, although these are based on multi-day trips and cannot be directly compared to the "inshore" fleet. Part of the reported yellowfin landings may actually be bigeye, due to species mis-identification. Observers have reported that most small tuna landed are actually bigeye.

The offshore handliners use a combination of methods to catch fish, not strictly limited to the "classic" ika-shibi or palu-ahi methods used in the areas closer to the islands. The methods used include a mixture of handline, trolling, and live-bait methods, although fish are still retrieved manually.

		Yellowfin			Bigeye			Albacore		
Year	Trips	Pounds	%HL	Lb/trip	Pounds	%HL	Lb/trip	Pounds	%HL	Lb/trip
1997	137	367,860	27.6	2,685	133,393	70.5	974	0	0	0
1998	**122**	**319,550**	**25.3**	**2,619**	**259,917**	**96.8**	**2,130**	**109,537**	**39.9**	**898**

Data: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (i.e., does not include zero catch trips). These data are a subset of the combined tuna handline data reported earlier. Data combined from reported ika-shibi, palu-ahi, and drifting handline methods for HDAR fishery statistical areas 15217 (NOAA weather buoy 4), 15717 (W2), 15818 (Cross Seamount), 16019 (W3) and 16223 (W1). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available.

Commonwealth of the Northern Mariana Islands

Introduction

The Northern Mariana Islands pelagic fishery occurs primarily from the island of Farallon de Medinilla south to the island of Rota. The fishery is characterized using data in the Commercial Purchase Data Base. The collection system for the data is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Staff from the Department of Lands and Natural Resources, Division of Fish and Wildlife (DFW) routinely distribute and collect invoice books from 60 participating local fish purchasers on Saipan. Purchasers include practically all fish markets, stores, restaurants, hotels and roadside vendors ("fish-mobiles").

The current commercial purchase database collection system only documents landings on Saipan. The establishment of a data collection system for the islands of Tinian and Rota are in the process. It is believed that the commercial purchase database landings include over 90% of all commercial landings on Saipan, and over 80% of all NMI commercial landings.

Although the Saipan data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be used. It is assumed that data in this report are credible.

This database lacks information concerning fishing method, location, and effort because previous data generated from Creel Survey are believed to be unreliable. Estimates of total landings and CPUE's have yet to be generated.

To fish commercially within the NMI's exclusive economic zone (EEZ), commercial vessels over five net tons must have a Commercial Fishing License issued annually and jointly by the Department of Commerce and the Department of Lands and Natural Resources. Depending on the information supplied in the application package, the DFW may impose certain fishing restrictions in the form of license conditions. Although commercial boats under five net tons are not required to have a license to fish, all fishing boats are registered with the Department of Public Safety(DPS).

Summary

Trolling is the only fishing method utilized in the pelagic fishery. The pelagic fishing fleet, other than charter boats, consists primarily of vessels less than 24 ft in length which usually have a limited 20-mile travel radius from Saipan. In 1998, about 82% of all registered boats participated in some form of fishing activity. Seventy-Six vessels were identified as being involved in full-

time commercial fishing and 65 vessels were classified as part-time. Subsistence fishing and/or recreational usage included 143 vessels.

Twenty- four vessels were registered with the Boating Safety Office as charter vessels for 1998. Charter vessels generally retain their catches, selling half or more to local markets. While the general magnitude of charter boat sales is unknown, it is questionable whether the local market can absorb these catches without impacting commercial fishermen. No logbook system is currently in effect.

The primary marketable target species for the pelagic fleet is Skipjack tuna. Yellowfin and Mahimahi are also marketable species. During their seasonal runs, these fish are usually found close to shore and provide easy targets for the local fishermen. In addition to the economic advantages of being near shore and their relative ease of capture, these species are widely accepted by all ethnic groups. This has kept market demand fairly high due to the continuing immigrant population growth on Saipan (over half of the population on Saipan is non-native).

Three commercial fishing licenses were issued in 1998, four in 1997, and four in 1996. In 1998 one licensed vessel fished during the full 12-month calendar year. The vessel primarily targeted bottom fish, landing pelagics incidentally.

1997 Recommendations and **current status**

1. To request from WPRFMC for assistance in providing the CNMI with some expertise (training) in the area of offshore creel survey, both on data collection and analyzing.

Mr. David Hamm, from NMFS conducted a mini-work shop with us on Creel Surveys. This was to prepare us for our trip to Guam for Creel Survey training. While in Guam the Data Staff being assisted by DAWR staff, went through the different types of Creel Surveys. We mainly concentrated on the offshore creel survey. The training also covered interviewing methods and quality control.

2. To assist the CNMI in evaluating and salvaging its prior years offshore creel data collection as recommended by Mr. David C. Hamm of the Honolulu Laboratory. We are hopeful that the data collected in the past are adequate and useful for analyses.

A report was done by W.I.D.A. on September 1997.

3) A careful review and comparison of length frequencies and regional landings should be conducted to obtain general biological characteristics from the fishery.

Once we have implemented the Creel Survey, we will have data to do comparisons with length frequencies and regional landings in order to obtain general biological charateristics from the fishery.

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Table 1. NMI 1998 commercial pelagic landings, revenues and price

Species	Landings (lb)	Revenue ($)	Ave. Price ($/lb)
Misc. tunas	2,213	4,629	2.09
Skipjack tuna	133,819	267,718	2.00
Yellowfin tuna	11,656	25,559	2.19
Subtotal Above Tunas	**147,688**	**297,906**	**2.09**
Dogtooth tuna	14,426	34,775	2.41
Mahimahi	20,529	44,413	2.16
Marlin	3,361	5,968	1.78
Sailfish	83	168	2.02
Wahoo	5,039	11,632	2.31
Subtotal Other PPMUS	**43,438**	**96,956**	**2.14**
Troll fish	740	1,521	2.06
Barracuda	99	197	1.99
Rainbow runner	603	1,507	2.50
Subtotal Misc.	**1,442**	**3,225**	**2.18**
All Pelagics	**192,568**	**398,087**	**2.13**

Interpretation: Skipjack landings increased by 25% or over 27,000 pounds in 1998. Skipjack tuna continues to dominate the pelagic landings, comprising nearly 69% of the (commercially receipted) industry's pelagic catch. Mahimahi and Yellowfin tuna were still ranked second and third in total landings during 1998. Both Mahimahi and Yellowfin landings decreased by 18% and 32% from 1997 respectively . Skipjack tuna are easily caught in near shore waters throughout the year. Mahimahi are highly seasonal with peak catch rates usually from February through April. Yellowfin season usually runs from April to September. The overall pelagic catch increased over 17,000 pounds or 10% in 1998.

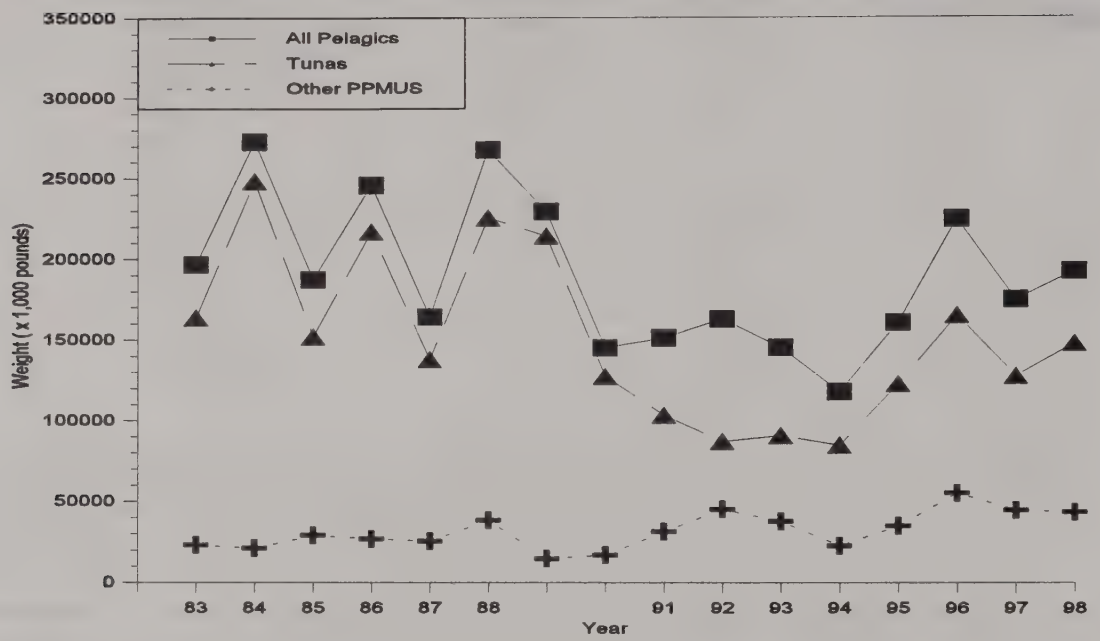
The highest average price of identified pelagic species was $2.50/lb for Rainbow Runner, which is down from the 1997 high of $2.66/lb. The lowest priced species remained Marlin at $1.78/lb, which decreased $0.06 from 1997. In 1998, Dogtooth tuna continued to increase in value over 1997 prices, from $2.27/lb to $2.41/lb. Wahoo increased in price from $2.26/lb to $2.41/lb. The average price per pound for Skipjack tuna, the species with the greatest landings, decreased by 8% from $2.17/lb in 1997 to $2.00/lb in 1998. The market share of total pelagic revenues by combining Yellowfin tuna and Mahimahi decreased from $92,905 or 24% in 1997, to $69,972 or 18% in 1998. Skipjack revenue increased from $230,951 or 61% in 1997, to $267,718 or 67% of the total pelagic revenue in 1998.

Blue Marlin, which again brought the lowest average price in 1998, is taken primarily by charter boat fishers. The catch of Blue Marlin decreased from 5,655 pounds in 1997 to 3,361 pounds or by 41% in 1998. Other recreational fishers also catch Marlin during scheduled fishing tournaments. Although not generally regarded as a high quality food fish, marlin sashimi is sold in local restaurants and hotels. It is also served in public institutions. The low ex-vessel price may be partially related to the manner in which the fish is kept prior to sale. Other attributes of the Blue Marlin that may make it unpopular among the public are its' bulky

size and the relative quality of the cooked product. Fishers generally sell the whole fish to avoid cleaning and repackaging into smaller units.

Source and Calculation: Annual summaries for each species from the Commercial Purchase Data Base invoices.

Figure 1. NMI annual commercial landings: all pelagics, tuna and PPMUS.

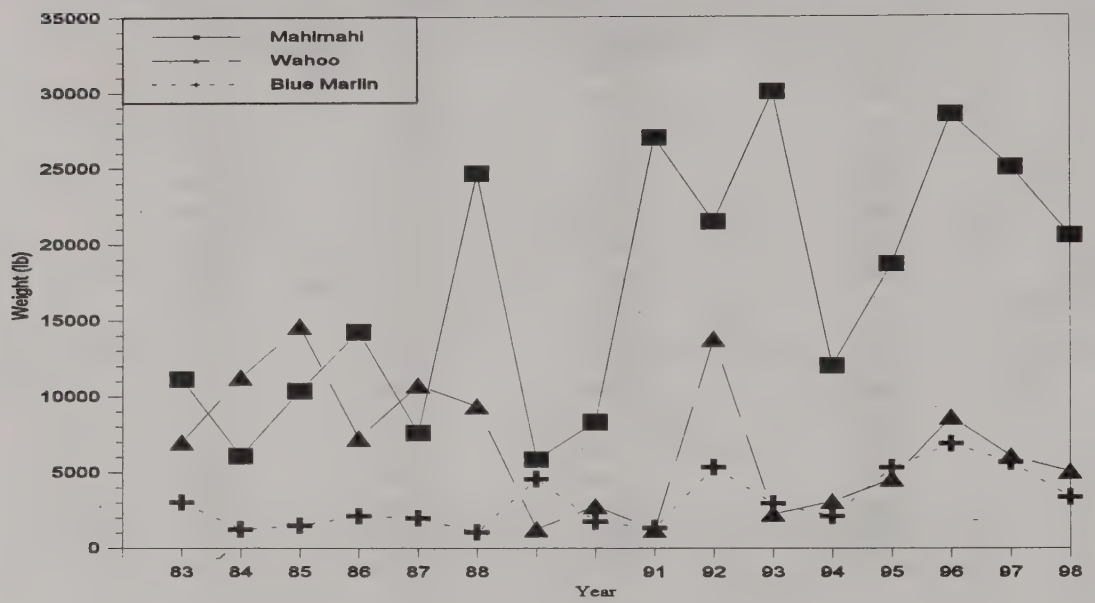


Interpretation: Total weight of pelagics landed in 1998 increased 10% from 1997 levels. Tuna landings have also increased 16% or over 20,000 pounds from 127,580 pounds in 1997 to 147,688 pounds in 1998. The increase in Tuna landings seem to be steadily climbing. Catch in the 'Other PPMUS' category remained fairly stable with an overall decrease of 1018 pounds or 2%.

Source and Calculation: All pelagics, tuna and other PPMUS landings were summed from the Commercial Purchase Data Base.

	Total Landings (lb)		
Year	**All Pelagics**	**Tunas**	**Other PPMUS**
1983	196,788	163,754	23,081
1984	272,909	248,339	21,223
1985	187,378	151,882	29,105
1986	245,967	217,023	26,800
1987	164,055	137,566	25,467
1988	267,619	225,498	38,368
1989	229,427	214,249	14,650
1990	144,862	127,172	16,893
1991	150,915	103,078	31,300
1992	162,691	86,931	45,061
1993	145,115	90,584	37,628
1994	117,668	8,4598	22,701
1995	160,540	122,616	34,863
1996	224,962	165,122	55,088
1997	174,914	127,580	44,455
1998	**192,568**	**147,688**	**43,439**
Average	189,899	150,855	31,883
Standard Deviation	46,327	51,846	11,430

Figure 2. NMI annual commercial landings: mahimahi, wahoo, and marlin.



Interpretation: Mahimahi landings decreased by 18% in 1998 from 25,021 pounds in 1997 to 20,529 pounds in 1998. It is noteworthy that the NMI and Guam Mahimahi catches have been fluctuating similarly since 1987, which may indicate a strong biological influence in local landing patterns.

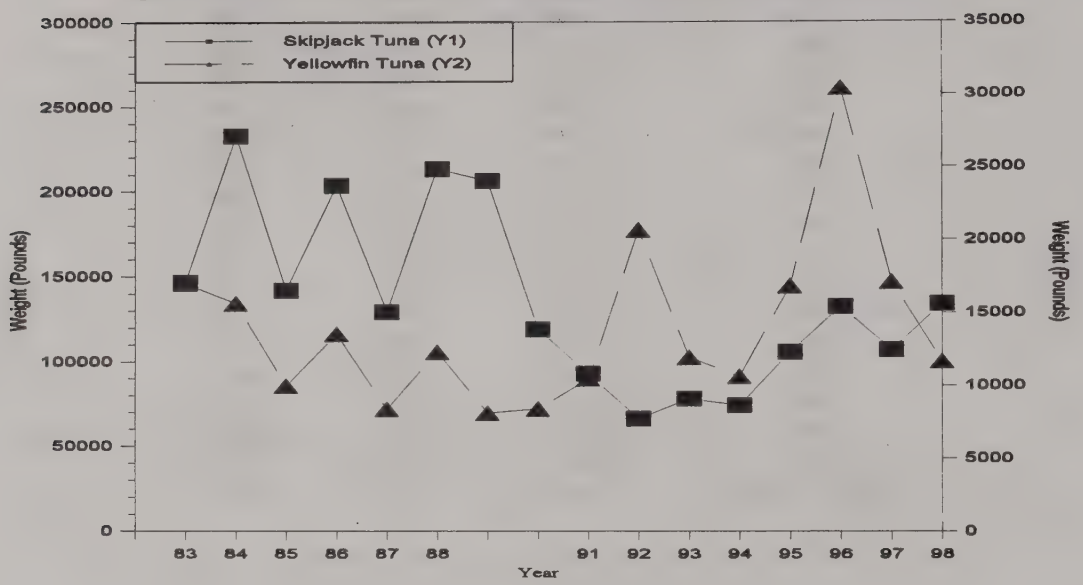
From 1983 to 1988, wahoo landings were somewhat consistent and did not fall below 7,000 lb, but in 1989 landings notably declined by 86% and remained at depressed levels until the dramatic increase in landings during 1992. Following the near-record 1992 landings, the 1993 wahoo landings again decreased by 84%, falling below the mean. Wahoo landings in 1998 decreased slightly by 1026 pounds or 17% over the 1997 landings.

The Blue Marlin landings for 1998 was 3,361 pounds which is a 41% decrease from 1997 figures.

Source and Calculation: The annual commercial landings of the three major PPMUS species (mahimahi, wahoo and blue marlin) were summed directly from the Commercial Purchase Data Base.

	Total Commercial Landings (lb)		
Year	**Mahimahi**	**Wahoo**	**Blue Marlin**
1983	11,151	7,008	3,030
1984	6,091	11,270	1,235
1983	10,364	14,601	1,488
1986	14,237	7,250	2,123
1987	7,602	10,723	1,968
1988	24,639	9,358	1,047
1989	5,856	1,257	4,563
1990	8,306	2,770	1,748
1991	27,005	1,217	1,320
1992	21,462	13,738	5,345
1993	30,036	2,257	2,950
1994	11,993	3,090	2,108
1995	18,657	4,555	5,295
1996	28,524	8,626	6,874
1997	25,021	6,064	5,655
1998	**20,529**	**5,039**	**3,361**
Average	16,967	6,801	3,132
Standard Deviation	8,480	4,287	1,850

Figure 3. NMI annual commercial landings: skipjack and yellowfin tuna.



Interpretation: Historically, Skipjack landings exhibited an alternating two-year cycle from 1983 to 1988 and comprised over 73% by weight of the total pelagic landings each year from 1983 to 1989 (data taken from Table 1 and Fig. 3). Skipjack tuna landings declined after that, reaching record lows from 1990 through 1994. In 1993 and 1994 Skipjack landings showed signs of stabilizing at about half of their respective eleven and twelve year means, while the nearly 32,000 pound increase in 1995 landings attained 61% of the 1983-1990 average of 174,020 pounds. In comparison to 1997 Skipjack landings, 1998 landings increased by 25%. This increase may be due to improved data collection and effort.

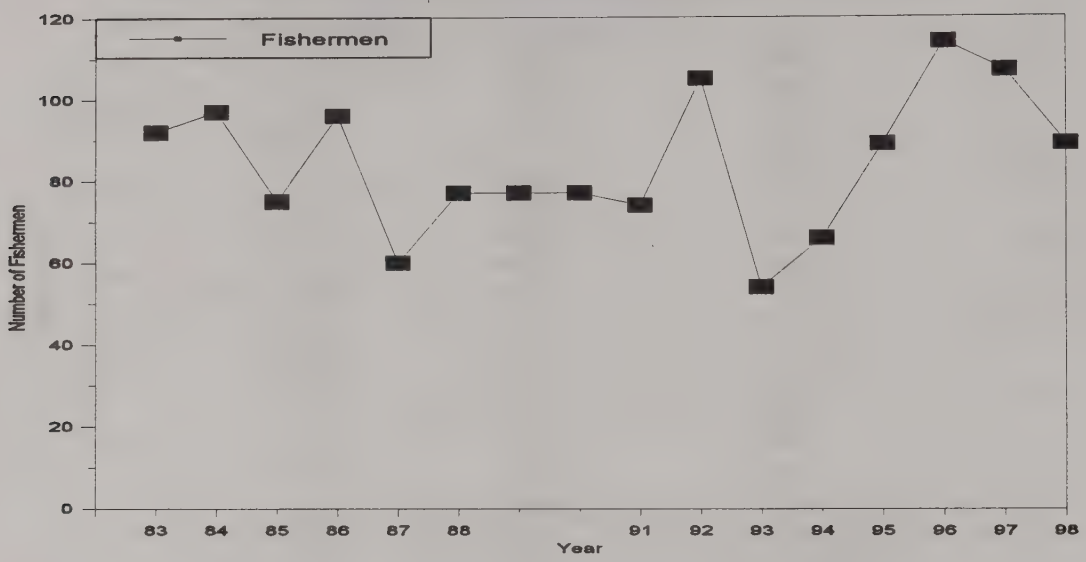
Schools of skipjack tuna have historically been common in near shore waters, providing an opportunity to catch numerous fish with a minimum of travel time and fuel costs. Skipjack are readily consumed by the local populace, primarily as sashimi.

Although more highly prized than Skipjack, Yellowfin tuna are not as common, and therefore not landed as often. The average fish size tends to be smaller when compared with Yellowfin tuna from other geographic areas. The 1998 landings for Yellowfin tuna decreased by 32% over 1997.The total landings in 1998 was 11,656 pounds compared to 17,121 pounds in 1997.

Source and Calculation: Landings were summed directly from the Commercial Purchase Data Base.

	Total Commercial Landings (lb)	
Year	**Skipjack tuna**	**Yellowfin tuna**
1983	146,729	17,025
1984	232,675	15,664
1985	141,910	9,973
1986	203,490	13,533
1987	129,203	8,363
1988	213,198	12,300
1989	206,162	8,087
1990	118,798	8,374
1991	92,642	10,433
1992	65,982	20,672
1993	77,832	11,919
1994	73,769	10,600
1995	105,423	16,824
1996	132,155	30,410
1997	106,757	17,121
1998	**133,819**	**11,656**
Average	136,284	13,935
Standard Deviation	52,359	5,746

Figure 3. NMI annual commercial landings: skipjack and yellowfin tuna.



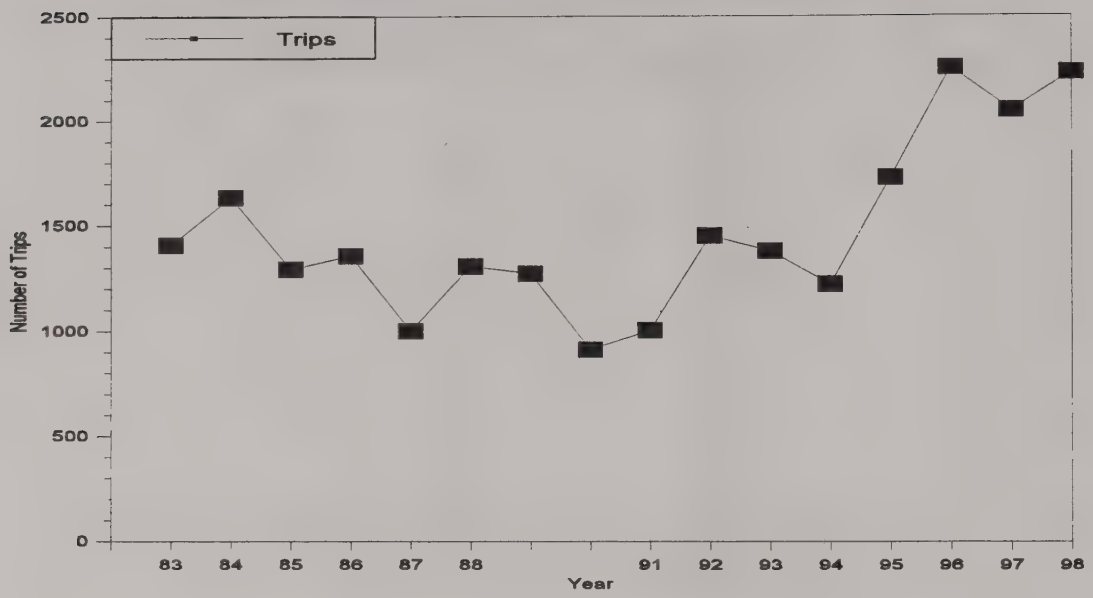
Interpretation: The number of fishers (boats) making commercial pelagic landings was relatively constant from 1988-91 compared to earlier years, but a record high number was recorded for 1992 (30% from 1991). Some of the increase in 1992 was attributable to the influx of new fishing boats as a result of money obtained by leasing property. In addition, it was discovered that some fishers were using several different boats, thus artificially inflating the total number of boats making pelagic landings.

Many of 1992's "new" fishers, with their new boats, are believed to have left the fishery during 1993. The number of fishers in 1998 decreased by17% from 1997. It has been suggested that the 1994 increase may have been due to the re-entry of repaired and refurbished boats from the 1992 fleet.

Source and Calculation: Each invoice from the Commercial Purchase Data Base records the fisherman's name from whom the fish were purchased. The number of fishermen who sold any pelagic species was calculated directly from the data invoices.

Year	No. fishermen landing any pelagic species
1983	92
1984	97
1985	75
1986	96
1987	60
1988	77
1989	77
1990	77
1991	74
1992	105
1993	54
1994	66
1995	89
1996	114
1997	107
1998	**89**
Average	84
Standard Deviation	17

Figure 5. NMI number of trips catching any pelagic fish.

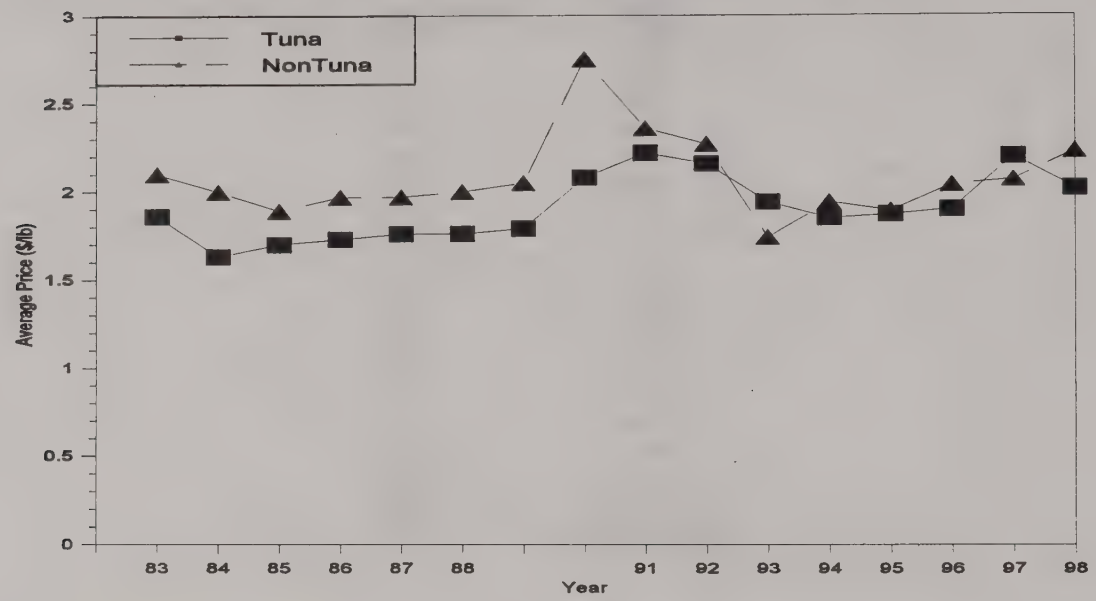


Interpretation: The number of pelagic trips increased in 1998 by 9% from 2,050 to 2,230. Although the number of pelagic trips dropped in 1997, the increase in 1998 figures is comparable to the 1996 all time high.

Source and Calculation: The total trips for all pelagic species were summed from the Commercial Purchase Data Base. Trips were calculated based on the assumptions that no fisherman makes more than one trip per day, and that all sales from a single trip are made on a single day.

Year	Number trips
1983	1,408
1984	1,634
1985	1,293
1986	1,356
1987	999
1988	1,306
1989	1,272
1990	910
1991	1,002
1992	1,451
1993	1,378
1994	1,221
1995	1,727
1996	2,254
1997	2,050
1998	**2,230**
Average	1,468
Standard Deviation	413

Figure 6. NMI average inflation-adjusted price of tunas and other PPMUS.



Interpretation: The inflation-adjusted average price of tuna was stable from 1983 until 1989, when an obvious rise was observed. The 1990-92 rise in price corresponds with the notable decrease in Skipjack tuna landings (Fig. 3) during the same period of time. In 1994 commercially receipted tunas commanded a lower price than in recent years. However, considering the inflation-adjusted prices from 1983 to 1996, it would appear that tuna prices have, on the whole, kept pace with inflation. Although there was an increase in tuna prices from 1996 to 1997, the prices decreased by 8% from 1997 to 1998.

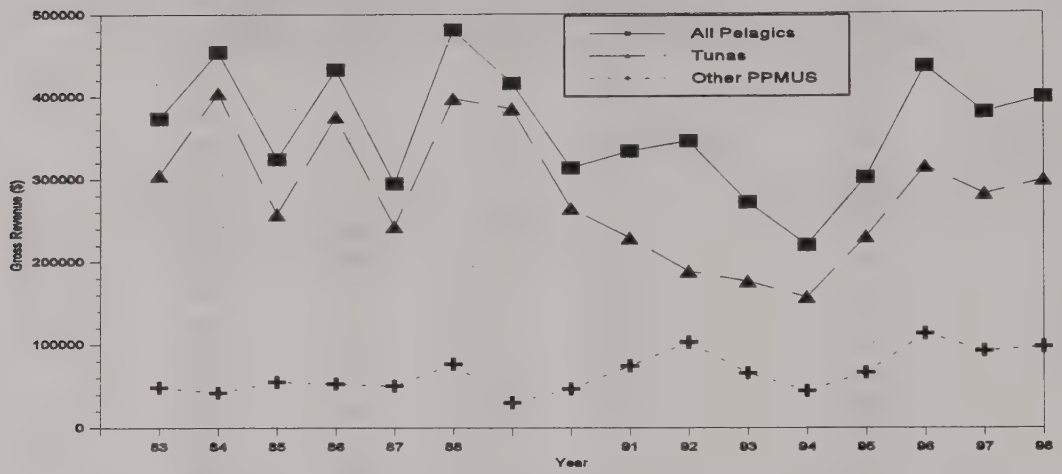
For 1998, the average price of "Other PPMUS" increased by 8% from 1997 rates.

Although there was a loss of the large Korean market in the CNMI, there appears to be no substantial loss to revenue. This may be attributed to a redirection of the market towards the local community.

Source and Calculation: The unadjusted average price is calculated by dividing the total revenues generated by the total weight sold. The inflation adjustment is made using the 1998 NMI Consumer Price Index (CPI) as the basis by which calculations of previous years' prices are made.

	Average Price ($/lb)			
	Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	0.99	1.86	1.12	2.10
1984	0.95	1.63	1.15	1.99
1985	1.02	1.70	1.14	1.89
1986	1.07	1.73	1.22	1.97
1987	1.14	1.76	1.27	1.97
1988	1.20	1.76	1.35	1.99
1989	1.29	1.79	1.48	2.05
1990	1.56	2.08	2.07	2.75
1991	1.80	2.22	1.92	2.36
1992	1.91	2.16	2.01	2.27
1993	1.78	1.94	1.59	1.74
1994	1.75	1.85	1.83	1.94
1995	1.80	1.87	1.81	1.89
1996	1.89	1.90	2.02	2.04
1997	2.20	2.20	2.07	2.07
1998	**2.02**	**2.02**	**2.23**	**2.23**
Average	1.52	1.90	1.64	2.08
Standard Deviation	0.42	0.18	0.39	0.24

Figure 7. NMI annual commercial adjusted revenues.



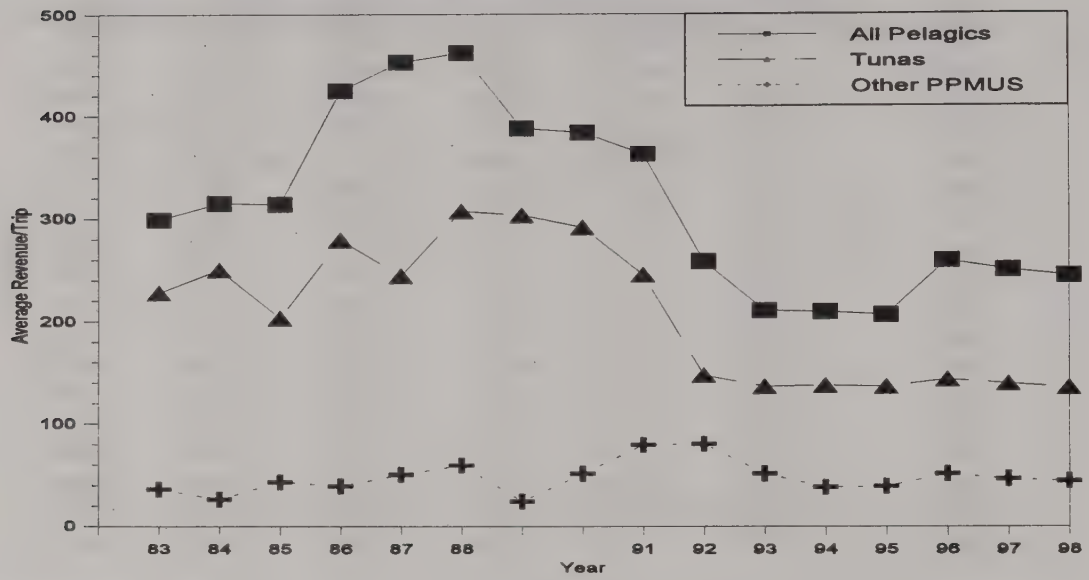
Interpretation: The erratic fluctuations of the inflation-adjusted revenues for Tunas and for All Pelagics prior to 1990 is most likely due to the annual variations in Skipjack tuna landings (see Fig. 3) which completely dominate the tuna category and, therefore, the All Pelagics category.

The tunas' inflation-adjusted revenues increased by 6% in 1998. There was also an increase of 5% for the "Other PPMUS" inflation-adjusted revenues. This may be the result of increased pelagic landings.

Source and Calculation: Annual revenue in dollars was summed separately for all pelagic fish, tunas and other PPMUS. Inflation-adjusted revenues were calculated using the Consumer Price Index, with 1998 as a base by which previous years' nominal prices are adjusted.

	Revenues ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	198,710	373,575	162,240	305,011	25,770	48,448
1984	264,203	454,429	235,262	404,651	24,503	42,145
1985	195,372	324,318	155,171	257,584	33,162	55,049
1986	267,013	432,561	231,745	375,427	32,631	52,862
1987	190,150	294,733	156,634	242,783	32,333	50,116
1988	327,260	481,072	270,679	397,898	51,950	76,367
1989	299,142	415,807	276,671	384,573	21,635	30,073
1990	235,520	313,242	198,775	264,371	34,968	46,507
1991	271,030	333,367	185,662	228,364	60,031	73,838
1992	305,927	345,698	166,235	187,846	90,627	102,409
1993	249,136	271,558	161,100	175,599	60,001	65,401
1994	207,124	219,551	147,940	156,816	41,548	44,041
1995	289,740	301,330	220,633	229,458	63,264	65,795
1996	431,560	435,876	311,271	314,384	111,445	112,559
1997	379,620	379,620	281,291	281,291	91,988	91,988
1998	**398,086**	**398,086**	**297,906**	**297,906**	**96,956**	**96,956**
Average	281,850	360,926	216,201	281,498	54,551	65,910
Standard Deviation	73,364	72,728	57,046	78,948	29,074	24,319

Figure 8. NMI annual commercial adjusted revenues for PPMUS trips only.



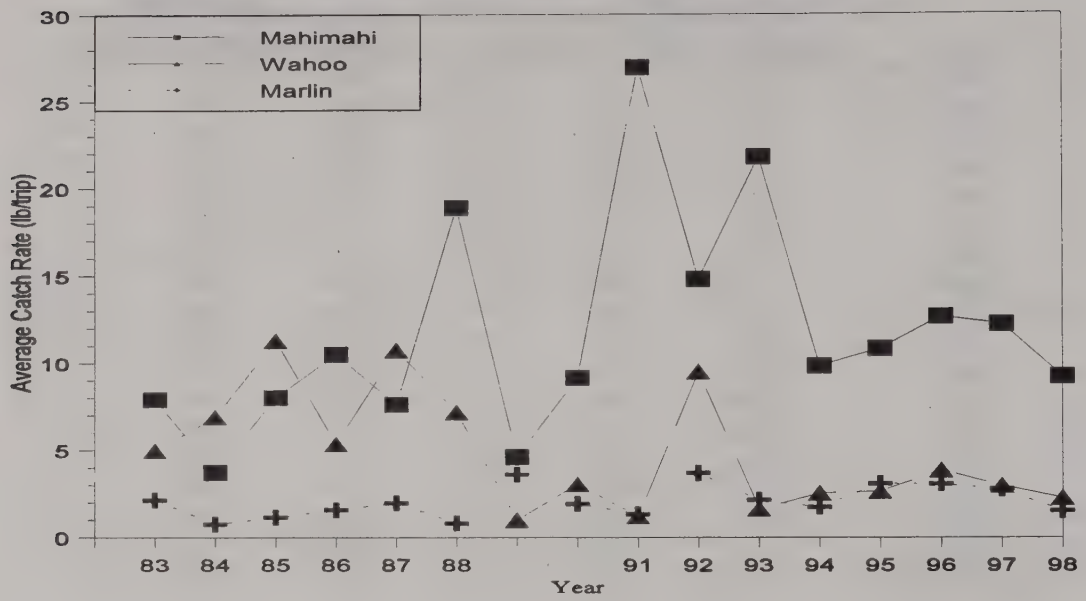
Interpretation: The inflation-adjusted revenues per trip for "All Pelagic Species" and "Tunas" indicates a decrease by 2% and 3% respectively, in 1998. "Other PPMUS" decreased by 4%. The current year values for all categories were below their respective 16 year means.

The revenue per trip for 1998 remained constant for all categories. This may be due to the increase in pelagic landings which result in more competitive prices.

Source and Calculation: Values were obtained by selecting, from the Commercial Purchase Data Base, all trips which landed at least one PPMUS, and then calculating a) the average revenue of all species, b) the average revenue of other PPMUS only, and c) the average revenue of tuna only.

	Revenues per PPMUS Trip ($)					
	All Pelagic Species		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	159	299	121	228	19	36
1984	183	315	145	250	15	26
1985	189	314	122	203	26	43
1986	262	425	172	279	24	39
1987	292	453	157	244	32	50
1988	315	462	209	307	40	59
1989	279	388	218	303	17	24
1990	289	384	219	291	39	51
1991	295	363	199	245	64	79
1992	228	258	130	147	71	80
1993	192	210	125	136	47	51
1994	197	209	129	137	36	38
1995	198	206	130	136	37	39
1996	256	259	141	143	51	51
1997	250	250	139	139	46	46
1998	**244**	**244**	**135**	**135**	**44**	**44**
Average	239	315	156	208	38	47
Standard Deviation	48	88	36	68	16	16

Figure 9. NMI trolling catch rate of mahimahi, wahoo and marlin.



Interpretation: The 1998 Mahimahi catch rate decreased by 25% from 1997, which fell below the 16 year mean. This could be due in part to the absence of FADs, which attract the species, making it more accessible. It may also be biological because it appears that the trolling catch rates of Guam and the NMI have fluctuated similarly over the last sixteen years.

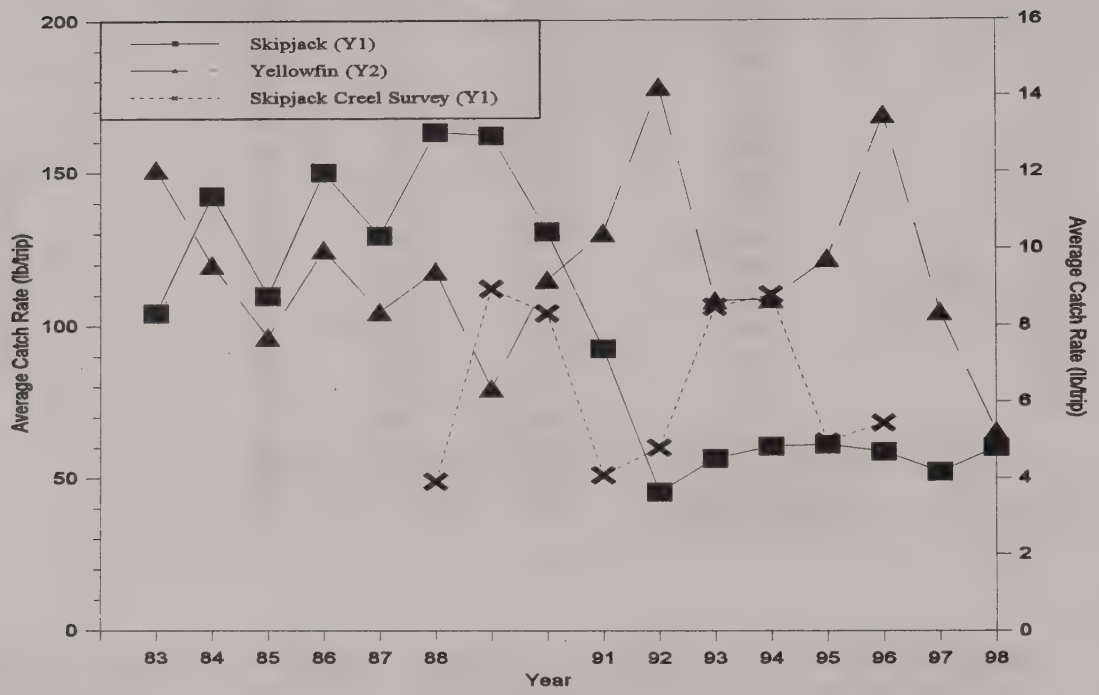
Prior to the 1989 record low, wahoo catch rates rivaled those for mahimahi. Wahoo catch rates have generally never regained those historical levels. The 1998 catch rate decreased by 24% from 1997, and remained less than the sixteen year mean of 4.81lb/trip.

Marlin catch rates declined by 45% from 1997 levels, continuing the trend of peaks every three years followed by declines of varying magnitude.

Source and Calculation: Annual catch rates for selected species were obtained by calculating the average weight per trip for each year. Trips were assumed to be one day in length and each commercial invoice assumed to represent one trip.

	Trolling Catch Rate (lb/trip)		
Year	**Mahimahi**	**Wahoo**	**Marlin**
1983	7.92	4.98	2.15
1984	3.73	6.90	0.76
1985	8.02	11.29	1.15
1986	10.50	5.35	1.57
1987	7.61	10.73	1.97
1988	18.87	7.17	0.80
1989	4.60	0.99	3.59
1990	9.13	3.04	1.92
1991	26.95	1.21	1.32
1992	14.79	9.47	3.68
1993	21.80	1.64	2.14
1994	9.82	2.53	1.73
1995	10.80	2.64	3.07
1996	12.65	3.83	3.05
1997	12.21	2.96	2.76
1998	**9.21**	**2.26**	**1.51**
Average	11.79	4.81	2.07
Standard Deviation	6.18	3.37	0.92

Figure 10. NMI trolling catch rates of skipjack and yellowfin tuna.



Interpretation: Catch rates for Skipjack tuna decreased dramatically commencing in 1990. The 1992 through 1997 catch rates have appeared to stabilize around the six year mean of 55.7lb/trip. Compared to the Creel Survey data on Skipjack tuna from 1988 through 1996 we see a difference in catch. Skipjack tuna are the preferred species in the troll fishery of the NMI because of their relative ease of capture and local popularity as sashimi. Previous discussions have suggested that non-tuna PPMUS may be increasing in value and a slight shift in target troll fish may be occurring, especially since the Skipjack tuna no longer appears to be as abundant.

Catch rates of Yellowfin tuna per trip decreased by 38% from 1997 levels. Yellowfin tuna, although more highly prized than skipjack, are not encountered often and are usually taken incidentally while targeting other species. The very sharp decline in landings(Table 1), and catch rate may be indicative of the current oceanographic conditions caused by La Nina.

Source and Calculation: Data were summarized from the Commercial Purchase Data Base, which provides average pounds caught per trip. Annual catch rates for selected species were obtained by calculating the average weight per trip for each year. Trips were assumed to be one day in length and each commercial invoice represents one trip.

	Trolling Catch Rate (lb/trip)	
Year	**Skipjack**	**Yellowfin**
1983	104.21	12.09
1984	142.40	9.59
1985	109.75	7.71
1986	150.07	9.98
1987	129.33	8.37
1988	163.25	9.42
1989	162.08	6.36
1990	130.55	9.20
1991	92.46	10.41
1992	45.47	14.25
1993	56.48	8.65
1994	60.42	8.68
1995	61.04	9.74
1996	58.63	13.49
1997	52.08	8.35
1998	**60.01**	**5.23**
Average	98.64	9.47
Standard Deviation	42.94	2.33

Appendix 5

International

The areas administered by the Council are surrounded by large and diverse fisheries targeting pelagic species. This report summarizes information on the reported catches of pelagic species in the Pacific Ocean between 40° S and 40° N by fleets of various nations during 1997 and 1998. The information was assembled from several sources:

- Data on the geographic distribution of catch and effort by the United States purse seine fleet were supplied by the National Marine Fisheries, Service Southwest Region, Pacific Islands Area Office, from data reported under terms of the United States and Pacific Island multilateral fishing treaty.
- Data on the Hawaii based longline fishery were supplied by the National Marine Fisheries Service, Southwest Region, Honolulu Laboratory.
- Data on the geographic distribution of catches, aggregated by 5° degree geographic square, gear type and month, between 40° S and 40° N in the western Pacific were supplied by the Secretariat of the Pacific Community (SPC) under the terms of a special request from the WPRFMC.
- Data on the geographic distribution of catches, aggregated by 5° degree geographic square, gear type and quarter, in the Eastern Tropical Pacific were supplied by the Inter-American Tropical Tuna Commission.
- Documents presented to the June 16 – 23, 1999, meeting of the Standing Committee on Tuna and Billfish in Tahiti were used to prepare summaries of stock status.

Caveats and general interpretations

- This report was assembled from a variety of sources. There is no general consistency between sources in units of reporting or in geographic conventions, nor is the extent of coverage by fleet and geographic area always clear.
- All data are "second hand", and therefore it is impossible to verify their accuracy. At best, it is possible to state that the tables and figures reported here accurately reflect the data as supplied.
- Much of the data on which the reports are based were compiled during the first half of 1999 and it is likely that estimates of 1998 catch may be based on incomplete data. Problems were encountered assembling the data from the various sources and it was impossible to obtain a complete data set for 1998. Therefore some tables and figures refer to 1997 and others to 1998.
- In some cases, catch in numbers or "pieces" have been converted to weight by the agency that supplied the data using conversion factors of unknown accuracy.
- The 5° resolution of the catch distribution maps occasionally gives the impression that fishing has occurred within an EEZ when it fact the fishing occurred in the 5° square that contains the boundary of the EEZ.

Status of Stocks.

Skipjack are the mainstay of the industrial tuna fishery in the Pacific. The estimated skipjack catch in the western Pacific in 1998 was1.17 million metric tonnes (mt), the highest catch since 1991. The bulk (76%) of this catch and most of the increase over 1997 was taken by purse seine. Indicators of stock status, based on pole and line and purse seine statistics, are variable in time and place indicating regional variability in exploitation rate, but there is no detectable downward trend in catch rates.

The best indicators of the status of skipjack stocks are based on tagging studies conducted by the Secretariat of the Pacific Community (SPC, formerly the South Pacific Commission) in the early 1990s. At that time, the exploitation rate was considered to be relatively low. Current catch levels are similar to those achieved in the early 1990s and there are no clear trends in catch rates indicating that current catch levels are sustainable.

Yellowfin rank second in total harvest. The estimated catch of yellowfin in the western Pacific has been increasing since the 1980s and was a near record 407,000 mt in 1998. Purse seine catches contributed most of the increase while catches by longline and pole-and-line decreased.

Catch rate indicators from the different purse seine fleets show no consistent trend, and "standardized" longline catch per unit of effort (CPUE) is relatively flat. Preliminary results from the MULTIFAN-CL assessment of the western Pacific yellowfin stock shows regionally variable exploitation rates but moderate to low exploitation on the stock as a whole. Current yellowfin catch levels are considered sustainable and the yellowfin stock appears to be in good condition.

Bigeye catches are generally much lower than either skipjack or yellowfin. The total Pacific catch of bigeye in 1998 is estimated to be approximately 170,000 mt, of which 100,000 mt were taken in the western Pacific. Changes in purse seine fishing practices on both sides of the Pacific have caused increases in catches of juvenile bigeye by purse seiners. In the western Pacific, catches by both purse seine and longline increased. In contrast, longline catches in the eastern Pacific have decreased as purse seine catches of bigeye have increased.

The results of attempts to compute standardized indices of CPUE for bigeye indicate a decline in abundance since the 1970s in the western Pacific and since 1990 in the eastern Pacific. In spite of poor knowledge of key population parameters, the Inter-American Tropical Tuna Commission (IATTC) has conducted a cohort analysis of bigeye populations that also indicates a decline in adult biomass. Thus, there is general concern that adult bigeye biomass is declining, and the IATTC has taken action to decrease the level of exploitation on bigeye by the purse seine fleet in 1999.

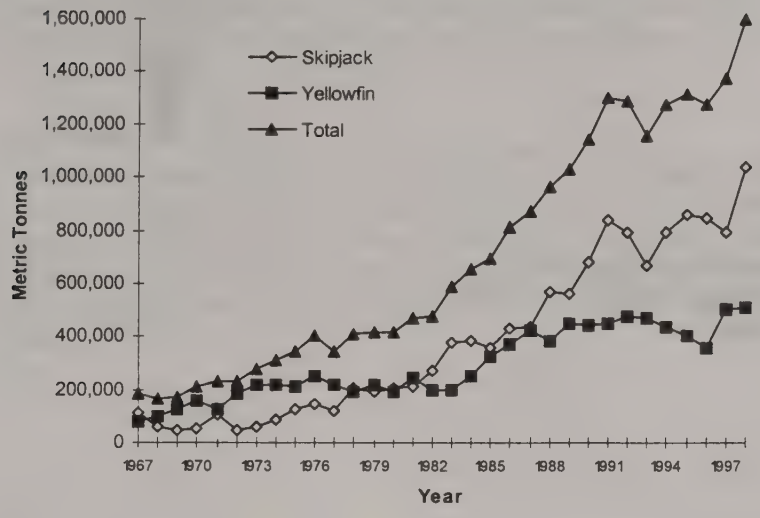
The 1998 catch of **southern albacore** was 41,000 mt, the highest in the last ten years. The bulk (88%) of the catch was taken by longline and the remainder by the troll fleet. Active domestic longline fleets targeting albacore have developed over the past few years in American Samoa, French Polynesia, and Samoa. The 1998 catch of these three fleets totaled 9,700, nearly 25% of the total south Pacific catch. The MULTIFAN-CL assessment of southern albacore based on data for the period 1962-1993 indicate that that current albacore catches in the south Pacific are sustainable.

Acknowledgments. Dr. John Sibert, manager of the Pelagic Fisheries Research Program at the University of Hawaii, coordinated preparation of this report. Ms. Dodie Lau of the PFRP and Mr. Keith Bigelow of the SPC prepared the figures, tables and maps. Mr. Johnoel Ancheta, also of the PFRP, assisted in manipulating the data files. Thanks to Mr. Tim Lawson and Mr. Keith Bigelow of the SPC, Mr. Michael Hinton of the IATTC, Dr. Sam Pooley of NMFS, Honolulu Lab, and Mr. Charles Karnella and Mr. Ray Clarke of NMFS/PIAO for responding to requests for information.

Table 1 Total reported purse seine catch of bigeye, skipjack and yellowfin tuna between 40° S and 40° N, in metric tonnes. Source: SPC and IATTC.

Year	Skipjack	Yellowfin	Bigeye	Total
1967	108,950	76,616	916	186,482
1968	61,987	101,048	2,496	165,531
1969	45,356	123,182	576	169,114
1970	52,687	155,166	2,058	209,911
1971	102,118	125,263	3,371	230,752
1972	46,125	181,232	3,037	230,394
1973	56,284	217,104	2,926	276,314
1974	87,897	220,025	2,279	310,200
1975	126,420	210,651	5,023	342,093
1976	142,863	249,092	11,448	403,403
1977	117,350	214,936	8,640	340,926
1978	205,101	189,610	12,860	407,571
1979	189,797	215,598	9,564	414,959
1980	206,223	192,489	17,483	416,194
1981	207,879	242,233	14,420	464,533
1982	269,374	196,856	9,187	475,417
1983	377,753	194,872	12,542	585,167
1984	384,006	251,306	14,485	649,797
1985	357,844	321,013	11,772	690,629
1986	431,095	370,102	9,538	810,734
1987	433,687	423,293	12,321	869,300
1988	569,348	382,602	8,316	960,265
1989	562,422	448,833	14,246	1,025,501
1990	676,604	444,073	16,881	1,137,559
1991	835,022	445,859	17,266	1,298,146
1992	787,613	473,483	25,052	1,286,148
1993	662,166	466,565	22,391	1,151,122
1994	791,476	436,780	39,842	1,268,098
1995	853,035	404,745	49,931	1,307,712
1996	844,145	358,538	68,247	1,270,929
1997	790,451	499,807	81,686	1,371,944
1998	**1,031,103**	**510,274**	**54,103**	**1,595,480**
Average	387,943	291,976	17,653	697,573
Std. Dev.	306,683	132,019	19,862	445,033

Figure 1. Total purse seine catch of skipjack and yellowfin tuna, 1967-1998.
Source: SPC and IATTC.



Data

Data are aggregated from geographical summaries supplied by the SPC and IATTC. Fleets included are from Australia, Federated States of Micronesia, Indonesia, Japan, Kiribati, Korea, Mexico, New Zealand, Papua New Guinea, Philippines, Russia, Solomon Islands, Taiwan, United States, and Vanuatu.

Interpretation

The steady increase in purse seine catches that began in the late 1970s appears to have halted and catches have been relatively constant since 1993. The general leveling of catches since 1993 is usually attributed to a leveling of fishing effort due to a lack of demand for canned tuna products. The steady increase in reported bigeye catches in the surface fishery is noteworthy and continues to be a cause for concern in the Eastern Pacific Ocean.

Figure 2. Distribution of total purse seine skipjack catch in 1997 between 40° S and 40° N, by 5° geographic square.

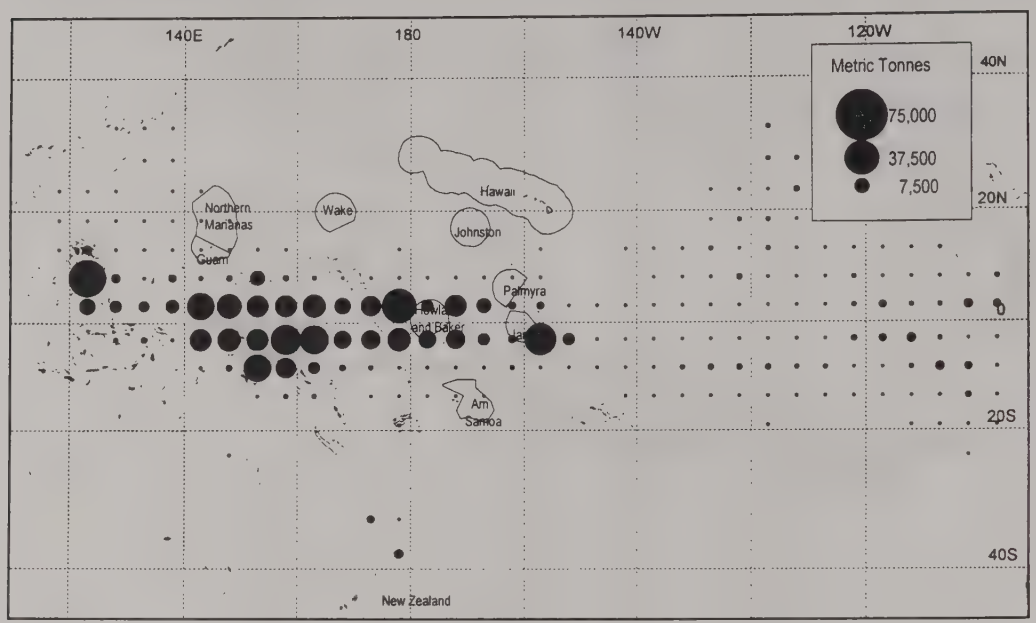
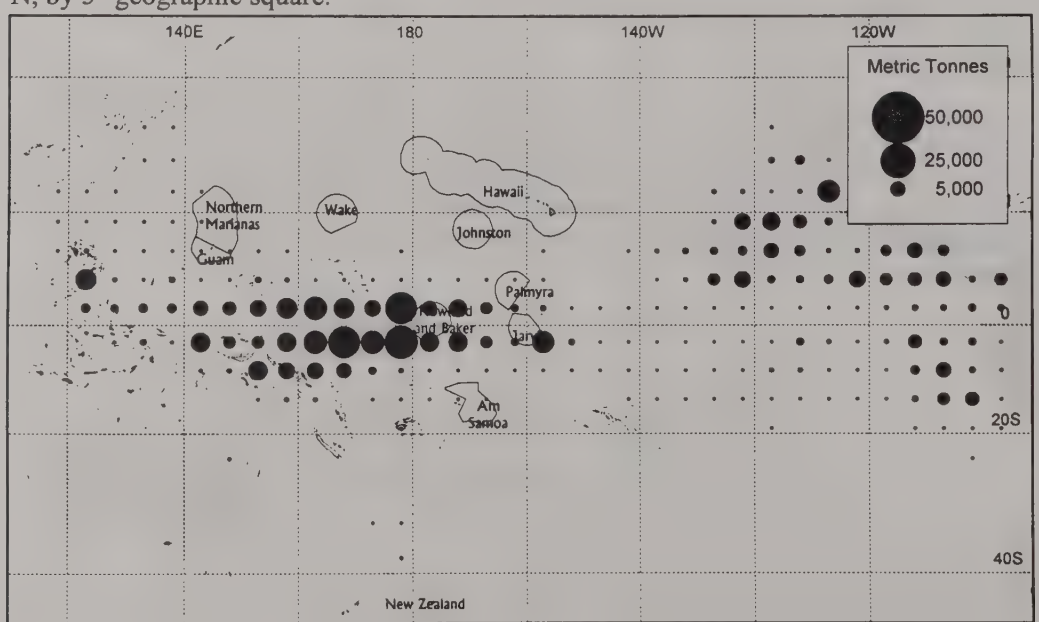


Figure 3. Distribution of total purse seine yellowfin catch in 1997 between 40° S and 40° N, by 5° geographic square.



Data

Data were supplied by the SPC and IATTC. Data are aggregated by 5° degree geographic square. Fleets included are from Australia, Federated States of Micronesia, Indonesia, Japan, Kiribati, Korea, Mexico, New Zealand, Papua New Guinea, Philippines, Russia, Solomon Islands, Taiwan, United States, and Vanuatu.

Interpretation

Skipjack and yellowfin are important components of purse seine catches in the highly productive fishing grounds in the equatorial western Pacific, principally in the EEZs of Papua New Guinea, Federated States of Micronesia, and Kiribati. Yellowfin dominate catches in the eastern Pacific. The extent of fishing activity in the western Pacific depends on the existence of bilateral fishing agreements between the Island States and the various DWFNs.

Figure 4. Distribution of United States purse seine effort in **1998** between 40° S and 40° N, by 5° geographic square.

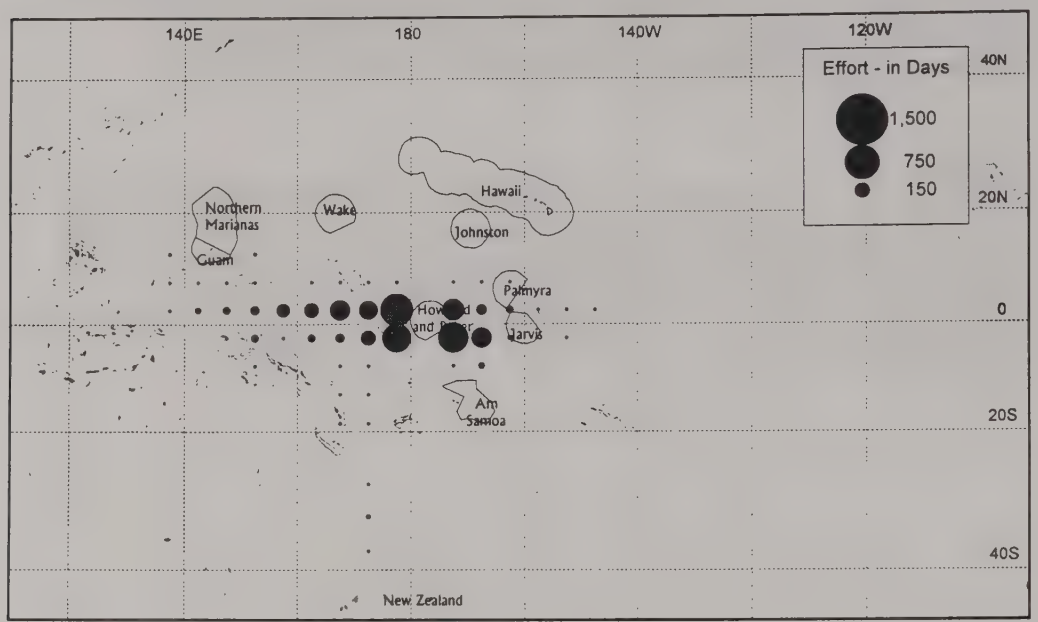


Figure 5. Distribution of United States purse seine catch of skipjack in **1998** between 40° S and 40° N, by 5° geographic square.

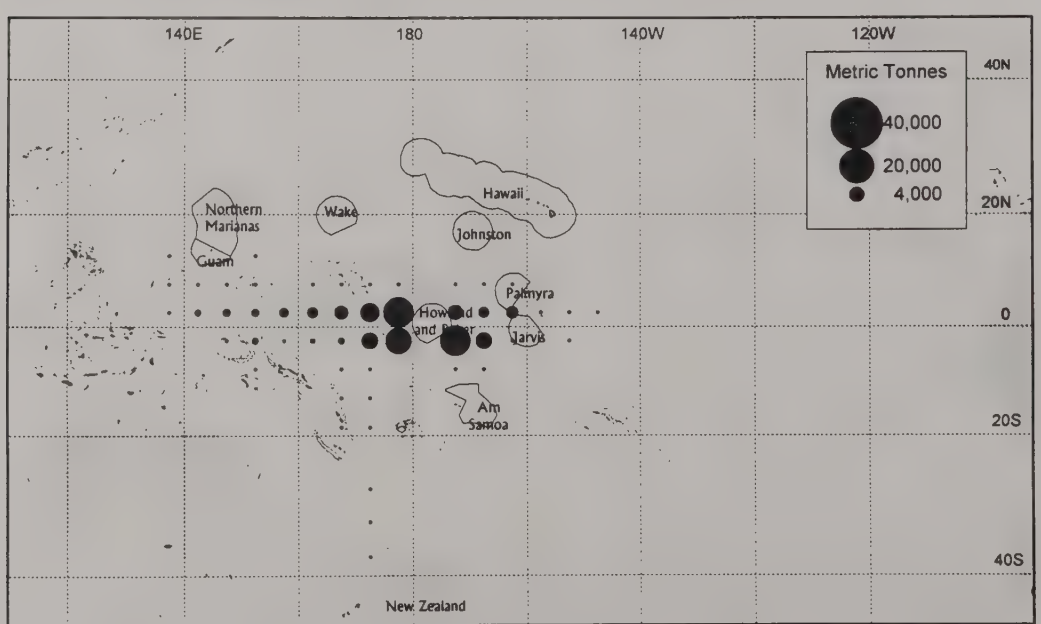


Figure 6. Distribution of United States purse seine catch of yellowfin tuna in **1998** between 40° S and 40° N, by 5° geographic square. (Reported yellowfin catch includes an unknown proportion of bigeye tuna.).

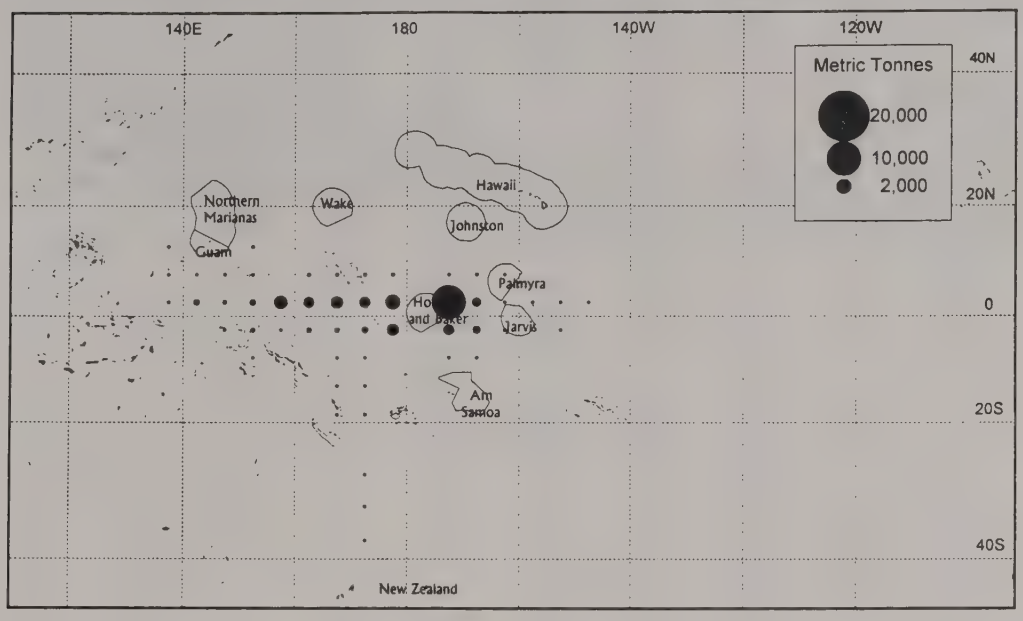


Table 2. United States purse seine tuna catches in U.S. EEZs in metric tonnes. (Yellowfin catch includes bigeye.)

Year	Country	Yellowfin	Skipjack
1990	Howland/Baker	8602	10354
	Palmyra	0	349
1991	Howland/Baker	26	1238
1992	Howland/Baker	3042	10051
1993	Howland/Baker	1247	11438
1994	Howland/Baker	2839	12013
	Jarvis	9268	4296
1995	Howland/Baker	32	435
1996	Howland/Baker	862	2945
1997	Howland/Baker	12854	17128
	Jarvis	2562	4362
	Palmyra	23	42
1998	Howland/Baker	5860	4459
	Average	3632	6085
	Std Deviation	4224	5502

Data

Data were supplied by the National Marine Fisheries, Pacific Islands Area Office from data reported under terms of the United States and Pacific Island multilateral fishing treaty.

Interpretation

The bulk of US purse seine activity occurs in the highly productive fishing grounds in the equatorial western Pacific, principally in the EEZs of Papua New Guinea, Federated States of Micronesia and Kiribati. There is sporadic activity in the US EEZ surrounding Howland, Baker, Jarvis and Palmyra islands.

Table 3. Total western Pacific longline catch of PMUS 1962-1997 between 40° S and 40° N, in metric tonnes. Source: SPC and NMFS, HL.

Year	Albacore	Bigeye	Bluefin	Yellowfin	Black Marlin	Blue Marlin	Sword fish	Striped Marlin	Total
1962	57,917	83,629	17,031	85,509	2,638	25,439	15,136	30,614	317,913
1963	36,981	80,562	18,687	67,047	2,342	19,032	11,414	26,602	262,667
1964	29,616	56,974	12,084	56,922	1,875	13,987	8,615	39,520	219,593
1965	26,445	44,929	13,470	55,479	2,373	11,065	9,660	32,593	196,013
1966	39,672	48,951	13,231	63,685	2,167	10,488	11,610	26,997	216,801
1967	48,525	50,831	8,365	40,328	1,822	9,695	12,041	31,767	203,374
1968	37,649	45,028	9,717	49,769	1,880	9,374	11,464	38,518	203,400
1969	28,402	59,663	8,832	52,101	2,071	10,338	14,352	25,412	201,172
1970	32,430	44,214	9,484	49,103	1,605	12,675	10,322	35,326	195,158
1971	28,986	42,570	12,262	45,609	2,126	8,047	9,406	30,741	179,748
1972	30,015	55,636	13,394	50,355	1,884	9,332	9,100	20,905	190,621
1973	29,477	54,844	7,383	54,643	1,935	9,958	9,598	18,562	186,400
1974	26,338	50,462	7,510	49,005	1,620	8,946	8,693	18,558	171,133
1975	23,565	56,141	4,480	54,227	1,845	7,961	9,124	15,181	172,525
1976	35,381	80,929	7,487	73,096	1,056	8,524	11,253	16,135	233,862
1977	41,747	93,515	4,579	87,017	937	8,506	11,039	9,424	256,765
1978	41,043	78,981	4,063	101,601	1,624	9,825	10,886	9,724	257,747
1979	34,868	85,740	5,000	101,498	1,950	10,256	11,157	15,638	266,108
1980	41,719	91,972	7,952	126,576	1,651	10,836	17,189	17,124	315,019
1981	50,245	79,921	204	95,798	2,065	12,703	21,715	19,470	282,121
1982	40,879	85,505	347	91,111	2,277	13,099	18,664	20,147	272,029
1983	35,890	84,440	222	88,649	1,915	10,728	20,229	13,765	255,838
1984	35,620	86,620	437	71,998	1,524	13,067	16,142	11,514	236,922
1985	36,110	113,121	1,816	84,404	1,233	10,953	18,547	12,101	278,283
1986	33,771	134,396	93	78,394	1,245	12,804	20,244	16,258	297,205
1987	32,914	131,962	432	84,196	1,760	17,264	24,689	19,572	312,788
1988	39,013	104,089	140	95,342	2,581	15,390	24,173	18,104	298,833
1989	27,965	107,410	264	79,274	1,454	13,087	19,952	14,830	264,237
1990	29,954	129,489	93	92,644	1,786	11,355	18,115	10,965	294,400
1991	36,878	118,934	5,860	73,028	1,994	12,400	19,127	11,307	279,529
1992	45,267	113,920	6,069	72,428	1,927	13,298	20,895	9,637	283,441
1993	49,680	104,751	688	75,237	1,622	14,785	20,730	11,379	278,871
1994	54,294	108,256	751	85,398	1,655	16,314	18,198	12,263	297,129
1995	56,351	92,032	424	78,787	1,113	15,824	15,701	13,129	273,361
1996	55,591	74,061	983	71,927	872	11,457	16,119	8,691	239,701
1997	**52,564**	**83,718**	**1,541**	**72,756**	**1,194**	**13,877**	**22,562**	**12,032**	**260,244**
Ave.	38,438	82,172	5,705	73,748	1,767	12,297	15,218	19,292	248,638
S.D.	9,477	27,081	5,411	19,391	436	3,501	4,970	8,833	44,084

Data

Data are aggregated from geographical summaries supplied by the SPC. Fleets included are from American Samoa, Australia, China, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Japan, Korea, Marshall Islands, New Caledonia, New Zealand, Papua New Guinea, Solomon Islands, Tonga, Taiwan, United States, and Western Samoa. Longline catch is reported to the SPC in "pieces" and converted to weight (metric tons) using average weight estimates for each species.

Figure 7. Longline tuna catches between 40° S and 40° N, 1962-1997. Source: SPC and NMFS, HL.

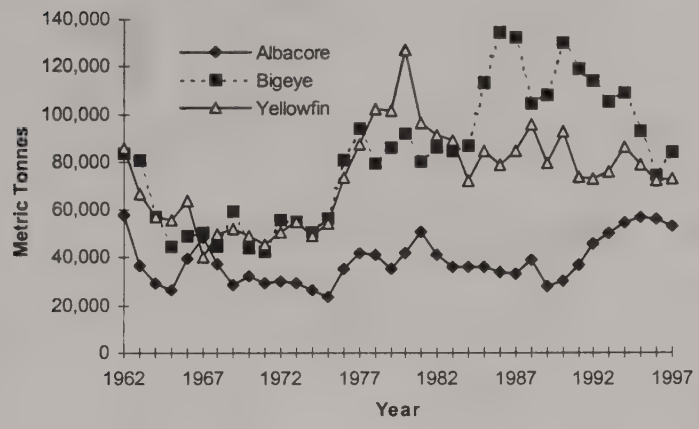


Figure 8. Distribution of longline catches of all tuna species in 1997 between 40° S and 40° N, by 5° geographic square.

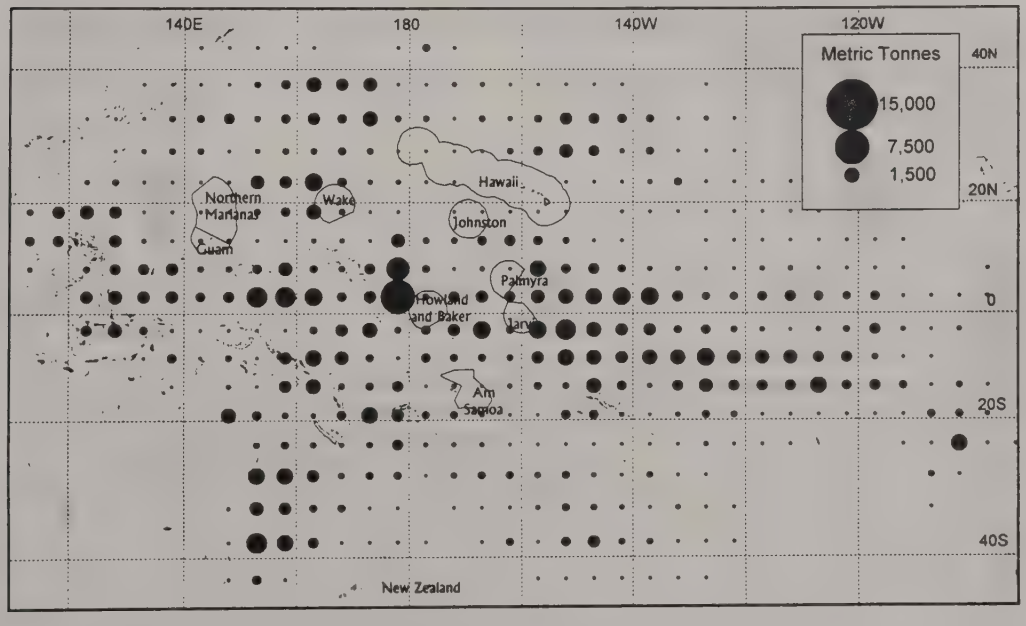


Figure 9. Distribution of longline catches of yellowfin tuna in 1997 between 40° S and 40° N, by 5° geographic square.

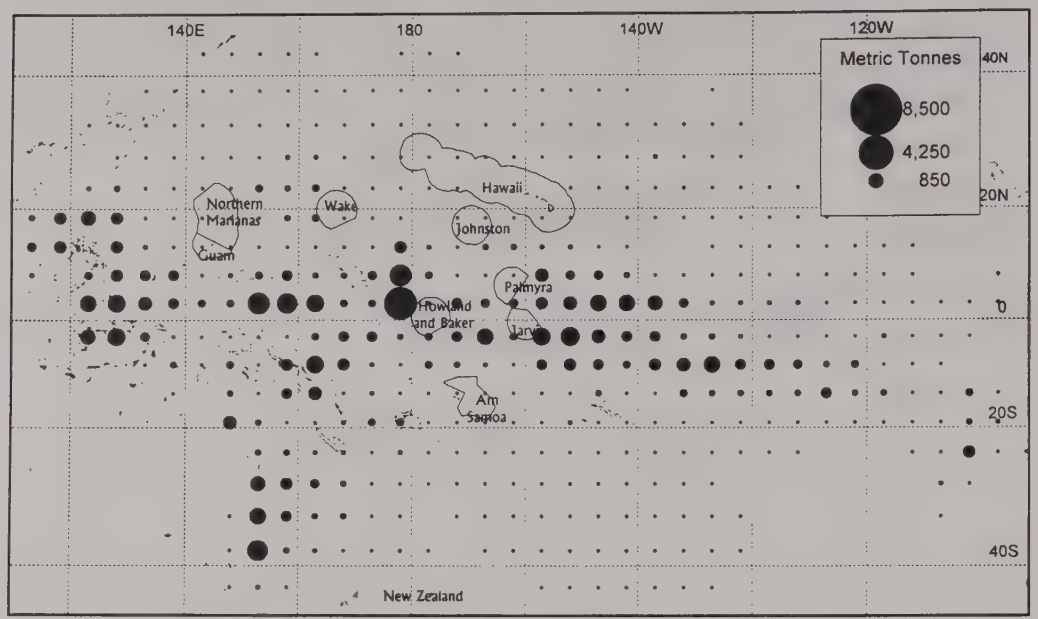


Figure 10. Distribution of longline catches of bigeye tuna in 1997 between 40° S and 40° N, by 5° geographic square.

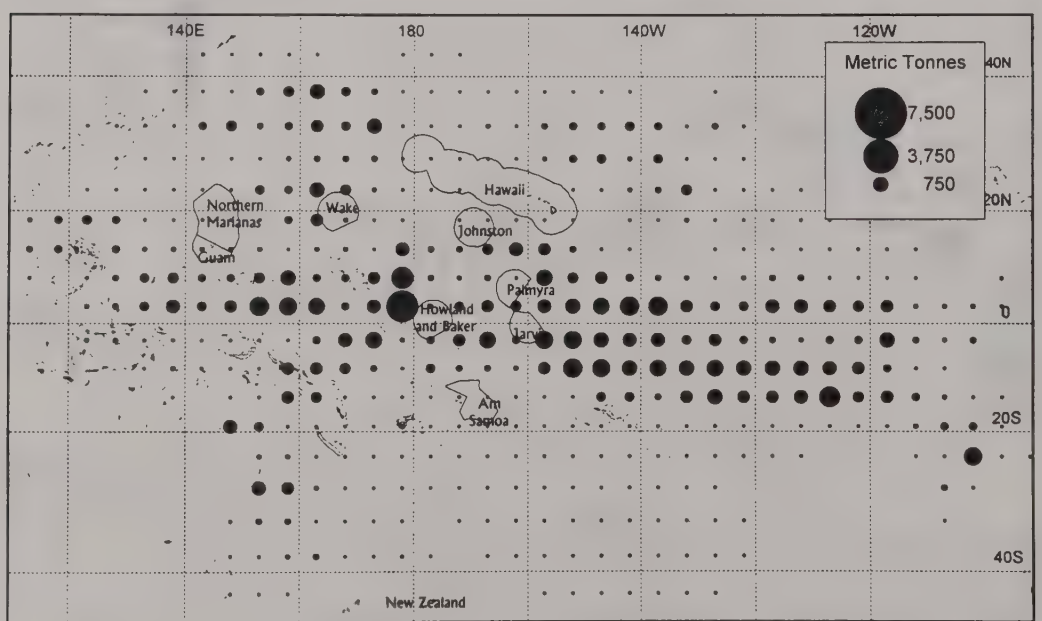


Figure 11. Distribution of longline catches of albacore tuna in 1997 between 40° S and 40° N, by 5° geographic square.

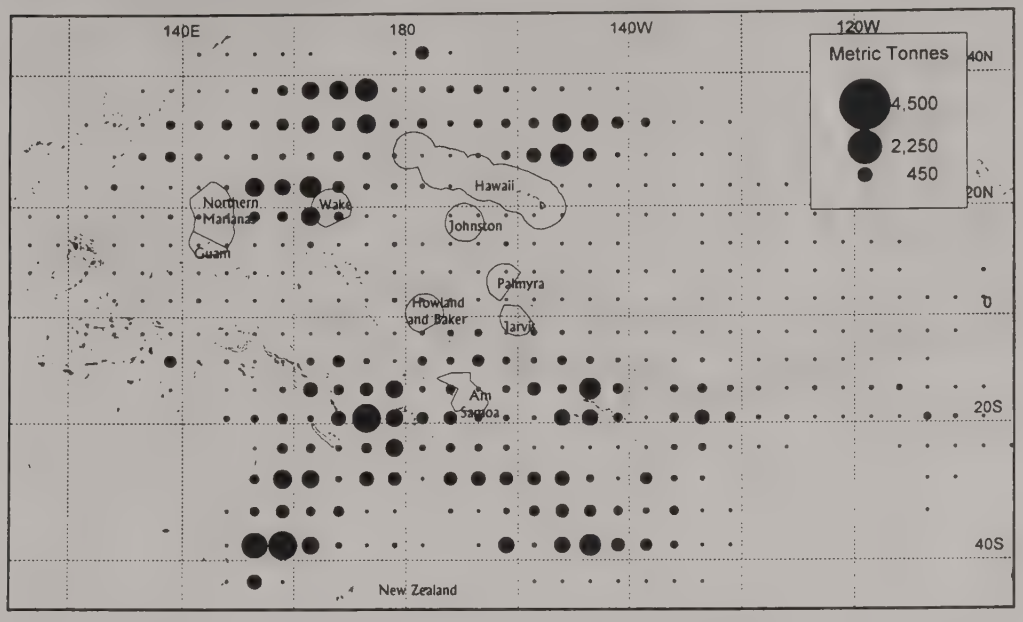


Figure 12. Distribution of longline catches of bluefin tuna in 1997 between 40° S and 40° N, by 5° geographic square.

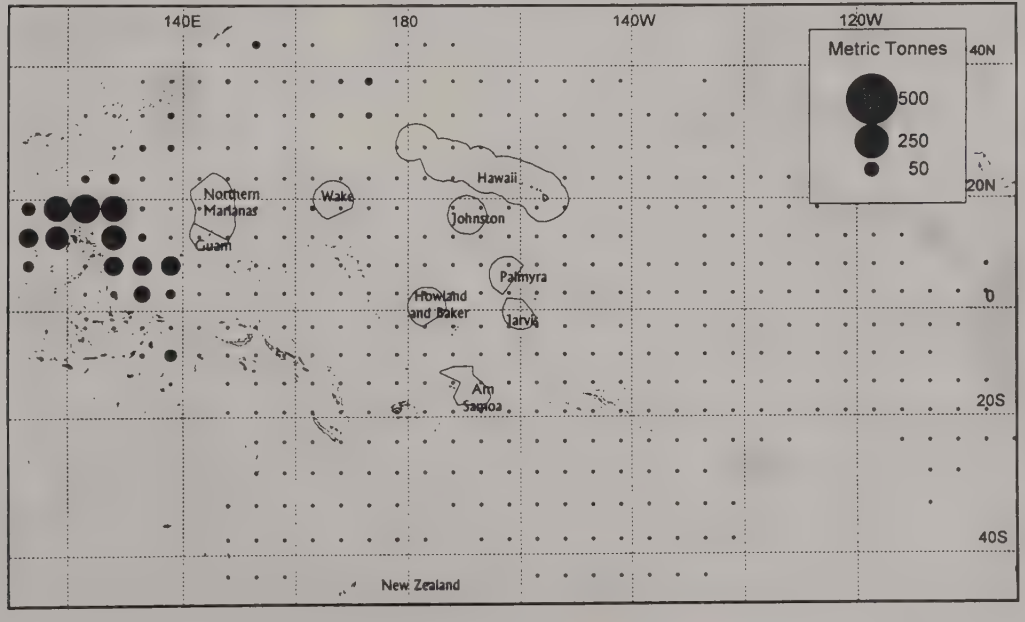


Figure 13. Longline billfish catches in the SPC Statistical Area, 1962-1997. Source: SPC and NMFS, HL.

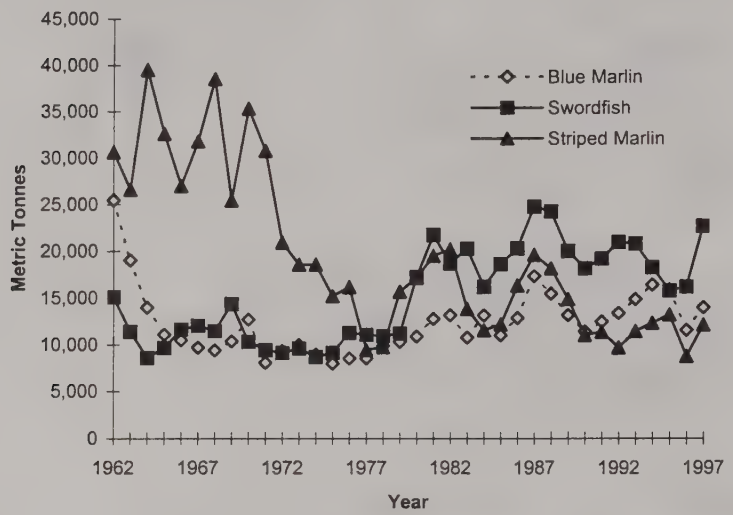


Figure 14. Distribution of longline catches of swordfish in 1997 between 40° S and 40° N, by 5° geographic square.

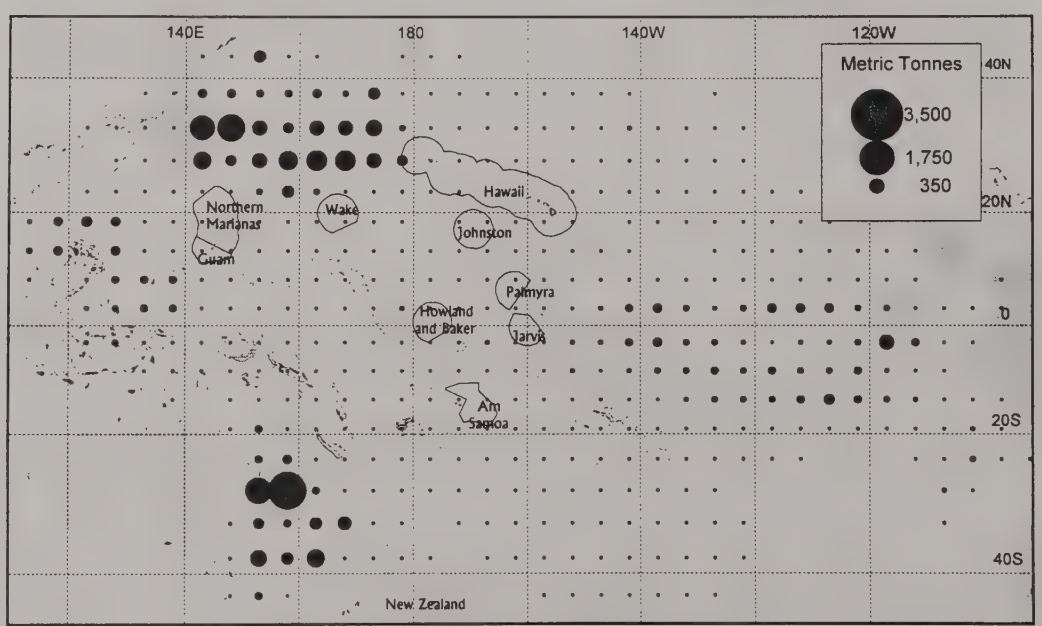


Figure 15. Distribution of longline catches of blue marlin in 1997 between 40° S and 40° N, by 5° geographic square.

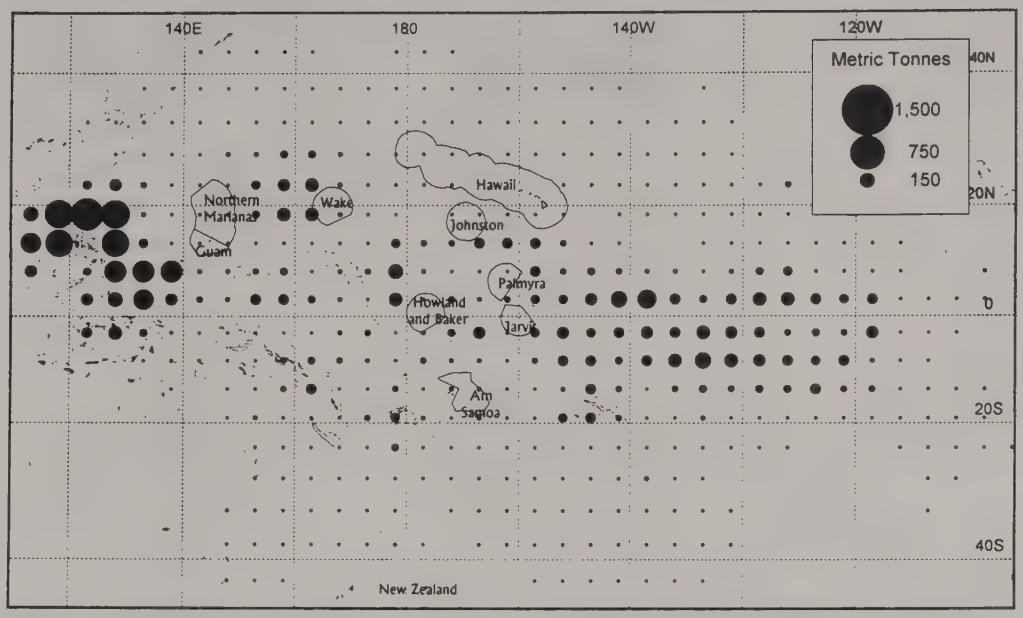


Figure 16. Distribution of longline catches of striped marlin in 1997 between 40° S and 40° N, by 5° geographic square.

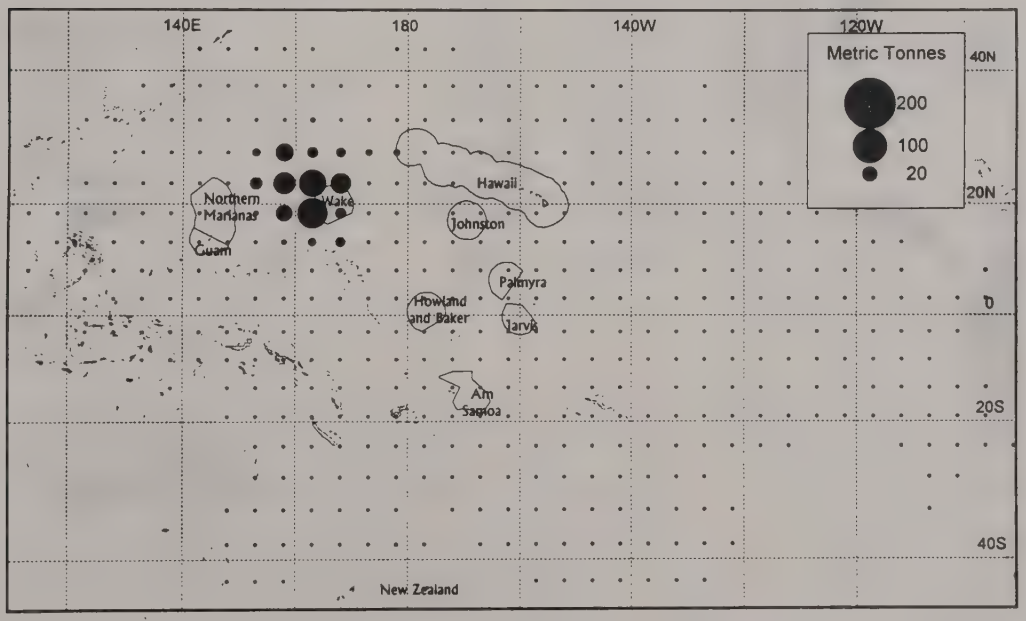


Table 4. Total western Pacific pole and line catch of skipjack 1970 – 1997, between 40° S and 40° N, in metric tonnes. Source: SPC.

Year	Skipjack
1970	197,873
1971	180,945
1972	171,488
1973	253,007
1974	289,068
1975	217,930
1976	276,387
1977	294,522
1978	331,146
1979	283,460
1980	332,399
1981	296,444
1982	262,303
1983	300,658
1984	380,140
1985	250,463
1986	338,624
1987	262,476
1988	297,623
1989	286,777
1990	225,526
1991	289,210
1992	228,655
1993	270,121
1994	220,363
1995	252,720
1996	204,827
1997	**226,410**
Average	265,056
Std. Dev.	49,800

Figure 17. Total western Pacific pole and line catch of skipjack 1972 -1997 in metric tonnes. Source: SPC.

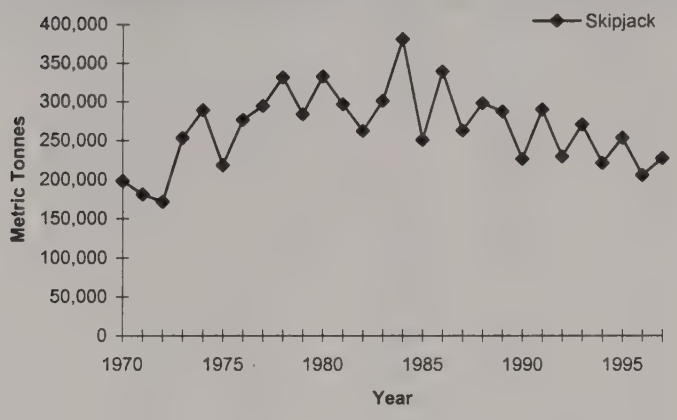
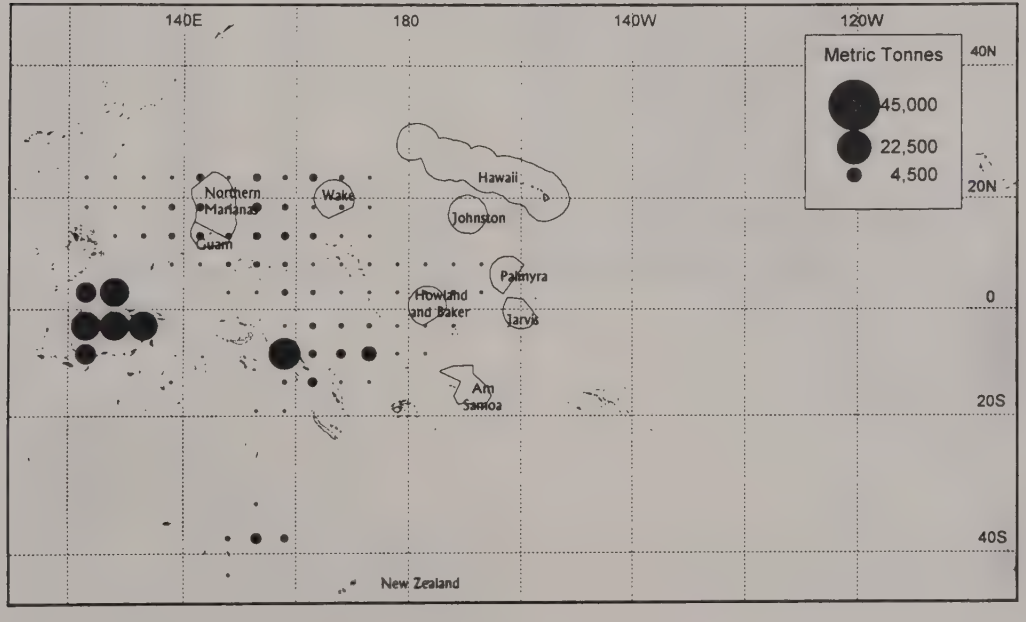


Figure 18. Distribution of pole and line catch of skipjack in the western Pacific in 1997 between 40° S and 40° N, by 5° geographic square.



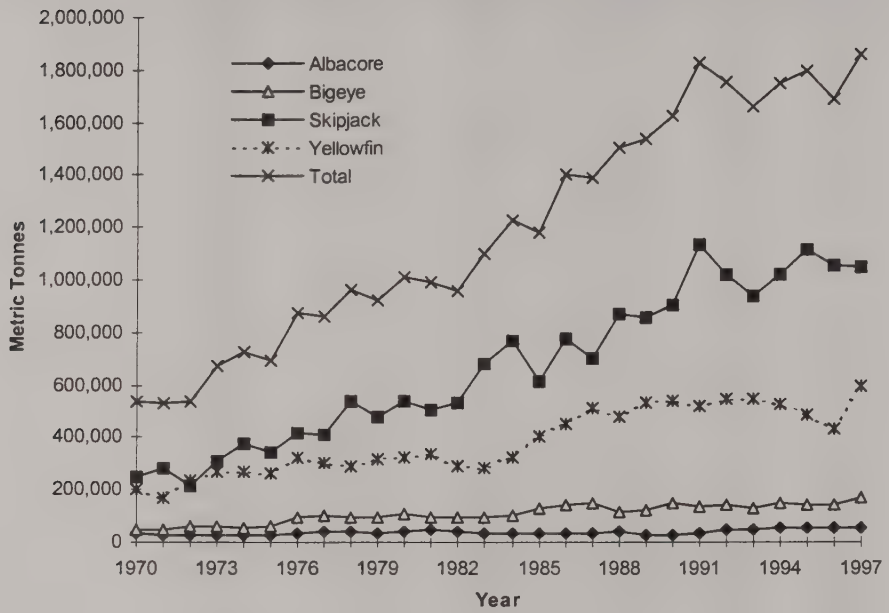
Data

All data on pole and line landing were supplied by the SPC. Fleets included are from Australia, Fiji, French Polynesia, Japan, Kiribati, New Caledonia, Palau, Papua New Guinea, Solomon Islands, and Tuvalu. The data on which this table is based has been revised by the SPC after receipt of more recent data from the Japanese pole and line fleet.

Table 5. Estimated annual catch of tuna species in the Pacific between 40° S and 40° N, in metric tonnes. Source: SPC, IATTC and NMFS, HL.

Year	Albacore	Bigeye	Skipjack	Yellowfin	Total
1970	32,430	46,272	250,560	204,343	533,605
1971	28,986	45,942	283,063	170,872	528,862
1972	30,015	58,737	217,613	231,586	537,952
1973	29,477	57,796	309,291	271,747	668,311
1974	26,338	52,741	376,965	269,030	725,074
1975	23,565	61,164	344,349	264,878	693,956
1976	35,381	92,428	419,250	322,188	869,248
1977	41,747	102,397	411,872	301,953	857,969
1978	41,043	91,994	536,247	291,211	960,495
1979	34,868	95,530	473,257	317,096	920,751
1980	41,719	109,682	538,622	319,065	1,009,088
1981	50,245	94,543	504,324	338,031	987,143
1982	40,879	94,881	531,677	287,967	955,404
1983	35,890	97,173	678,410	283,521	1,094,994
1984	35,620	101,333	764,146	323,304	1,224,403
1985	36,110	125,126	608,307	405,416	1,174,960
1986	33,771	144,162	769,718	448,495	1,396,147
1987	32,914	144,514	696,163	507,489	1,381,080
1988	39,013	112,648	866,971	477,944	1,496,577
1989	27,965	122,011	849,198	528,107	1,527,282
1990	29,954	146,817	902,130	536,717	1,615,619
1991	36,878	136,749	1,124,232	518,887	1,816,746
1992	45,267	139,505	1,016,268	545,911	1,746,951
1993	49,680	127,700	932,288	541,802	1,651,469
1994	54,294	148,681	1,011,839	522,177	1,736,991
1995	56,351	142,547	1,105,755	483,532	1,788,185
1996	55,591	142,891	1,048,972	430,465	1,677,918
1997	**52,564**	**165,987**	**1,038,394**	**588,002**	**1,844,946**
Ave.	38,520	107,213	664,638	383,276	1,193,647
Std. Dev.	9,301	35,138	287,436	123,042	439,389

Figure 19. Estimated total annual catch of tuna species in the Pacific between 40° S and 40° N, in metric tonnes.



Appendix 6

Pelagic fisheries production from the Pacific West Coast States

Introduction

This is the second occasion on which this report has featured data for pelagic fisheries production from the Pacific West Coast States. The following four tables show the time series of landings for the last two decades. The 1997 annual report gives some explanation on these landing trends and this remains more or less unchanged up to the present. The last two tables show the relative contributions by states, and indicates that pelagic landings of species other than albacore are significant only in California, and this applies mainly to landings in the southern part of the state (87% of landings for all species).

Table 1. Annual landings of pelagic fish in the Pacific West Coast States (Washington, Oregon, California), 1981-1998. Source: Pacific States Marine Fisheries Commission

West coast highly migratory species landings (mt) by species 1981-98									
	1981	1982	1983	1984	1985	1986	1987	1988	1989
Yellowfin Tuna	76091.27	61769.27	55740.51	35062.81	15024.65	21517.08	23201.04	19519.74	17615.10
Skipjack Tuna	57,869.41	41,904.25	44,995.42	31,251.48	2,976.60	1,360.96	5,723.98	8,863.02	4,505.29
Bluefin Tuna	867.62	2,404.49	763.54	635.50	3,253.80	4,731.50	822.86	803.63	1,018.85
Albacore	13,712.41	5,408.06	9,573.89	12,657.38	7,301.15	5,242.99	3,159.51	4,907.95	2,214.46
BigeyeTuna	1,167.89	967.81	21.38	125.81	6.63	28.71	49.73	6.44	0.62
OtherTuna	57.54	50.76	101.96	1,014.46	470.21	143.14	129.26	11.05	76.82
Swordfish	749.35	1,112.11	1,757.66	2,889.51	3,417.91	2,529.57	1,802.80	1,635.82	1,357.11
MakoShark	182.45	351.11	217.22	159.72	149.10	311.56	402.54	321.76	255.42
ThresherShark	1,521.43	1,876.52	1,436.00	1,345.73	1,285.42	1,022.85	583.44	510.40	521.16
BlueShark	92.26	26.67	7.13	1.80	1.15	1.61	1.77	3.29	6.15
OtherShark	687.74	604.73	610.56	848.76	1,414.36	1,352.88	1,072.35	563.76	363.61
Grand Total	152,999.37	116,475.78	115,225.27	85,992.96	35,300.98	38,242.85	36,949.28	37,146.86	27,934.59
	1990	1991	1992	1993	1994	1995	1996	1997	1998
Yellowfin Tuna	8,509.13	4,177.51	3,349.65	3,794.92	5,055.72	3,038.45	3,346.66	4,773.98	5,613.62
Skipjack Tuna	2,255.61	3,407.35	2,585.88	4,538.96	2,111.03	7,036.97	5,454.68	6,069.88	5,797.89
Bluefin Tuna	925.38	103.83	1,087.08	558.80	915.56	713.80	4,686.71	2,249.09	1,945.74
Albacore	3,029.59	1,676.13	4,885.46	6,150.57	10,685.99	6,528.30	14,028.05	11,197.17	13,619.20
Bigeye Tuna	2.24	7.32	6.67	25.54	46.70	47.91	62.43	47.89	50.63
OtherTuna	46.04	11.46	10.18	78.96	112.72	101.91	86.83	55.10	240.69
Swordfish	1,235.64	1,029.31	1,545.56	1,770.58	1,699.69	1,161.23	1,177.71	1,253.66	1,364.81
Mako Shark	373.37	218.67	142.01	122.16	127.92	95.22	94.23	128.42	96.95
ThresherShark	388.78	615.32	314.46	319.57	366.93	305.25	331.97	363.66	337.17
Blue Shark	19.89	0.66	1.37	0.48	12.23	5.33	0.76	0.52	2.89
OtherShark	322.59	251.33	191.05	140.37	96.93	88.38	94.92	112.44	129.18
Grand Total	17,108.26	11,498.89	14,119.37	17,500.91	21,231.42	19,122.75	29,364.95	26,251.81	29,198.77

Table 2. Annual revenues of pelagic fish in the Pacific West Coast States (Washington, Oregon, California), 1981-1998. Source: Pacific States Marine Fisheries Commission

West coast highly migratory species exvessel revenues (1998 $) by species, 1981-98									
Species	1981	1982	1983	1984	1985	1986	1987	1988	1989
Yellowfin Tuna	168,754,128	119,766,522	91,184,862	55,331,404	17,858,511	24,985,187	32,548,563	33,506,726	23,650,072
Skipjack Tuna	113,415,038	65,154,830	56,620,231	36,751,556	2,772,139	1,341,081	5,868,165	12,376,868	4,988,717
Bluefin Tuna	2,156,152	4,320,509	1,638,773	1,368,814	4,048,713	6,491,143	2,846,842	4,359,835	1,651,800
Albacore	45,333,241	12,904,063	18,775,058	25,646,956	11,979,803	8,724,531	6,950,497	12,044,654	4,779,800
Bigeye Tuna	2,682,827	1,828,626	70,815	259,729	25,403	126,622	240,022	33,123	2,946
Other Tuna	130,883	159,013	180,803	1,674,131	1,269,074	277,322	610,219	62,958	159,839
Swordfish	5,733,793	8,224,426	10,523,477	17,362,994	19,163,740	17,904,806	15,110,887	12,758,514	10,375,949
Mako Shark	277,412	545,183	354,040	282,236	277,608	599,637	970,706	852,021	693,824
Thresher Shark	2,524,320	3,204,055	2,409,810	2,519,184	2,748,373	2,459,374	1,640,080	1,299,945	1,210,798
Blue Shark	100,933	30,244	7,062	3,504	3,254	1,548	2,518	2,867	4,541
Other Shark	1,169,974	829,614	788,772	1,011,483	1,457,755	1,347,259	1,254,336	688,380	471,074
Grand Total	342,278,701	216,967,085	182,553,703	142,211,991	61,604,373	64,258,810	68,042,835	77,985,891	47,989,360
	1990	1991	1992	1993	1994	1995	1996	1997	1998
Yellowfin Tuna	10,283,896	4,631,130	4,327,917	6,317,055	4,853,315	3,198,372	3,323,503	5,183,918	5,686,632
Skipjack Tuna	2,316,271	3,070,463	1,575,782	3,431,170	1,879,793	5,027,067	4,104,878	5,540,612	5,185,542
Bluefin Tuna	1,406,257	134,967	1,334,173	825,018	1,798,999	1,107,347	4,154,172	2,830,309	2,972,349
Albacore	6,778,323	3,285,584	12,961,206	12,752,677	21,866,772	12,139,795	27,822,457	19,941,493	18,381,788
Bigeye Tuna	10,718	49,676	50,460	233,959	329,699	259,556	268,081	184,067	256,656
Other Tuna	68,319	24,858	23,854	110,266	97,083	87,086	67,315	45,920	202,599
Swordfish	8,641,858	7,353,139	8,542,901	9,869,807	10,303,630	6,878,739	6,172,773	5,502,735	5,840,293
Mako Shark	891,907	482,029	261,237	243,886	264,920	173,613	170,240	223,233	168,929
Thresher Shark	815,238	1,151,378	529,377	542,530	657,355	536,287	625,806	656,331	574,175
Blue Shark	15,529	873	2,017	669	17,235	2,935	544	272	5,989
Other Shark	384,751	291,577	224,190	183,756	118,482	116,813	109,828	139,969	158,811
Grand Total	31,613,067	20,475,674	29,833,114	34,510,793	42,187,283	29,527,910	46,819,597	40,248,859	39,433,863

Table 3. Total Landings and Revenue of highly migratory species from 1981-1998 by species and region

Total west coast highly migratory species landings (mt) by species and region, 1981-98.					
Species	S. California	N. California	Oregon	Washington	Coastwide
YellowfinTuna	367,149.49	50.45	1.17		367,201.11
Skipjack Tuna	238,695.92	12.22	0.40	0.12	238,708.66
Bluefin Tuna	28,315.02	169.25	3.51		28,487.78
Albacore	39,238.51	26,559.69	34,637.60	35,542.46	135,978.26
Bigeye Tuna	2,650.60	21.75			2,672.35
Other Tuna	2,771.39	27.63	0.07		2,799.09
Swordfish	22,048.42	7,379.48	59.64	2.49	29,490.03
Mako Shark	3,456.47	292.47	0.89		3,749.83
ThresherShark	11,375.12	1,294.92	601.26	174.76	13,446.06
Blue Shark	176.97	3.95	3.90	1.14	185.96
Other Shark	7,831.97	984.46	63.03	66.48	8,945.94
Grand Total	723,709.86	36,796.27	35,371.47	35,787.45	831,665.07

Total west coast highly migratory species exvessel revenues (1998 $) by species and region, 1981-98.					
Species	S. California	N. California	Oregon	Washington	Coastwide
Yellowfin Tuna	615,244,403	145,661	1,649		615,391,713
Skipjack Tuna	331,405,922	13,580	603	98	331,420,203
Bluefin Tuna	44,642,943	782,846	20,383		45,446,172
Albacore	85,262,154	59,649,881	70,326,886	67,829,777	283,068,698
Bigeye Tuna	6,806,505	106,780			6,913,285
OtherTuna	5,149,477	102,073	92		5,251,642
Swordfish	143,269,201	42,518,646	457,231	19,383	186,264,461
Mako Shark	7,167,415	562,572	2,674		7,732,661
ThresherShark	21,788,869	2,371,990	1,253,043	690,514	26,104,416
Blue Shark	187,785	6,498	6,797	1,754	202,834
Other Shark	8,901,286	1,591,277	114,291	139,970	10,746,824
Grand Total	1,269,825,960	107,851,804	72,183,649	68,681,496	1,518,542,909

Table 4. Average annual landings of highly migratory species by species and region, 1981-1998

Average annual west coast highly migratory species landings (mt) by species and region, 1981-1998					
Species	S. California	N. California	Oregon	Washington	Coastwide
Yellowfin Tuna	20,397.19	2.80	0.07	-	20,400.06
Skipjack Tuna	13,260.88	0.68	0.02	0.01	13,261.59
Bluefin Tuna	1,573.06	9.40	0.20	-	1,582.65
Albacore	2,179.92	1,475.54	1,924.31	1,974.58	7,554.35
Bigeye Tuna	147.26	1.21	-	-	148.46
Other Tuna	153.97	1.54	0.00	-	155.51
Swordfish	1,224.91	409.97	3.31	0.14	1,638.34
Mako Shark	192.03	16.25	0.05	-	208.32
Thresher Shark	631.95	71.94	33.40	9.71	747.00
Blue Shark	9.83	0.22	0.22	0.06	10.33
Other Shark	435.11	54.69	3.50	3.69	497.00
Grand Total	40,206.10	2,044.24	1,965.08	1,988.19	46,203.62

Average annual highly migratory species ex-vessel revenue (1998$) by species and region, 1981-1998					
Species	S. California	N. California	Oregon	Washington	Coastwide
Yellowfin Tuna	34,180,245	92	8,092	0	34,188,429
Skipjack Tuna	18,411,440	34	754	5	18,412,234
Bluefin Tuna	2,480,164	1,132	43,491	0	2,524,787
Albacore	4,736,786	3,907,049	3,313,882	3,768,321	15,726,039
Bigeye Tuna	378,139	0	5,932	0	384,071
Other Tuna	286,082	5	5,671	0	291,758
Swordfish	7,959,400	25,402	2,362,147	1,077	10,348,026
Mako Shark	398,190	149	31,254	0	429,592
Thresher Shark	1,210,493	69,614	131,777	38,362	1,450,245
Blue Shark	10,433	378	361	97	11,269
Other Shark	494,516	6,350	88,404	7,776	597,046
Grand Total	70,545,887	4,010,203	5,991,767	3,815,639	84,363,495

Appendix 7

Research and Publications on Pelagics by NMFS Honolulu Laboratory
(Excerpts from various NMFS reports)

FISHERY MONITORING

The National Marine Fisheries Service (NMFS) Honolulu Laboratory (the Lab) collects and processes fishery-dependent information from Federal logbooks and market monitoring, and via the Western Pacific Fishery Information Network (WPacFIN), which compiles island fisheries agency data from American Samoa, Guam, Hawaii, and the Northern Marianas. WPacFIN provides the island agencies with technical assistance. The lab also conducts economic research on pelagic fisheries. A major goal of the Lab is to ensure that the quality and quantity of fisheries-dependent data meet statistical and analytical requirements for conducting fisheries research. Increasingly, the Lab is involved in processing data from the NMFS longline fishery observer program operated by the Southwest Region (SWR) Pacific Islands Area Office (PIAO) in Honolulu. The Lab issues quarterly and annual reports on the Hawaii and American Samoa longline fisheries, estimates the domestic longline take of protected sea turtles and sea birds and produces other data reports for domestic fishery management bodies such as the Western Regional Fishery Management Council (Council) and international fishery management bodies like the Interim Scientific Committee for Research on Tuna and Tuna-like Species in the North Pacific (ISC), the Secretariate of the Pacific Community (SPC) Standing Committee on Tunas and Billfish (SCTB), and the Multilateral High Level Conference on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (MHLC).

Market Sampling Program - The present market sampling program has been conducted at the Honolulu auction since 1984. Laboratory and State of Hawaii Division of Aquatic Resources (HDAR) staff monitor the auction twice weekly to obtain fish weights, ex-vessel values, and sometime biological samples or specialized measurements. The Honolulu auction is the largest public fish auction in Hawaii and is the market for nearly all of the Hawaii longline fleet but the troll and hadline fisheries have diverse markets throughout the State. Fish weights and values are also monitored through HDAR commercial catch reports. WPacFIN receives sales receipts electronically from several dealers and is working with the State of Hawaii HDAR to implement a statewide seafood dealer reporting system. However, additional efforts may be needed to collect better size frequency and landings data from the Hawaii troll and handline fisheries.

Pelagic Fishery Status Reports - The Lab compiles most of the Hawaii module for the Council Pelagic Plan Team's Annual Report, integrating landings data from all gear types. Anuual and quarterly reports on the domestic longline fisheries are presented to the Council and its advisory groups on a regular basis, making it possible to evaluate the status of the fishery and make regulatory decisions. The information is also provided to *Fisheries of the United States*.

The Hawaii-based domestic longline logbook program is essentially a census (a complete and comprehensive accounting) of trips taken in the fishery. A dockside inventory of vessels operating out of Honolulu is also maintained. Although vessels which land in California operate under different rules, under a data sharing agreement the Lab receives both sets of logbooks which are processed and maintained in separate data bases. The American Samoa longline logbook program is not directly monitored by the Honolulu Laboratory (evidence from WPacFIN indicates that program has problems, see below). Lab staff continuously upgrade the longline reports to make them more accessible and complete, and are working with fishing captains on prototypes of electronic logbooks receivable via email. Summary data, including downloadable 5-degree square (non-confidential) area data, are now available on the Lab web site (below).

Hawaii Longline Fishery in 1998 - The Hawaii-based domestic longline fishery had a record year in terms of pounds landed (28.6 million pounds). However, revenue ($46.7 million ex vessel) decreased by $3.4 million. The total number of longline fishing vessels (114) was higher in 1998 than in

recent years but remains about 20% below the1990's peak. The largest change over recent years has been the shift in targeting from swordfish to tuna, with only 32 vessels taking swordfish-directed trips and only 7.4% of the trips targeting swordfish in 1998. A number of longline vessels targeting swordfish again operated out of California ports in 1988.

Most longline fishing trips were conducted outside the EEZ, but 50% of the trips made sets within the main Hawaiian Islands (MHI) EEZ. Trips can make sets in multiple areas, and only 28% of total sets were made within the MHI EEZ. There was also a substantial increase in the number of trips to the U.S. possession islands (Johnston Atoll and Palmyra/Kingman reef in particular). Swordfish, bigeye tuna and blue shark were the leading catch. About 60% (by number) of sharks caught were retained, primarily for fins, with landings valued at $1.5 million. Swordfish landings were 7.2 million pounds, valued at $11.9 million. Bigeye landings were 7.1 million pounds ($21.1 million); and albacore landings were 2.4 million pounds ($3.0 million), down substantially from 1997. Yellowfin landings tend to go in a biennial cycle, with 1998 being a down year (1.6 million pounds). Economic conditions have encouraged the landings of bigeye tuna for the sashimi market, instead of albacore for canneries.

Hawaii Longline Enforcement Cooperation - The Lab helped instruct NMFS Enforcement in species identification and participated in monitoring a sample of off-loadings in Honolulu harbor to cross-check logbook data. In response to an Enforcement request, to determine logbook accuracy, the Lab performed GAM (General Additive Model) analyses on logbook and observer counts of various catch categories to provide another type of cross-check. Catch data for 15 species taken by the Hawaii-based longline fishery on sets with fishery observers (N = 2,684 longline sets from March 1994 - December 1998) are also being tabulated to determine the percent concurrence between catch records from observers and logbooks and the frequencies of differences of various magnitudes. The tables may prove useful as accuracy references for given types of fishing trips. These cooperative activities have had a noticeable effect in improving the quality of the marlin species identifications, the count of secondary species, and the recording of shark fins.

Statistical Analyses of Hawaii Longline Catch Rates and Catch Composition - The statistical analyses described above were among many being conducted with longline logbook and NMFS fishery observer data to improve our understanding of catch composition, factors that influence catch, and catch-per unit effort (CPUE) trends, as well as logbook accuracy. In conducting this work, the Lab has been assisted by successful application for grants from the University of Hawaii - NOAA cooperative program's Joint Institute of Marine and Atmospheric Research (JIMAR) Pelagic Fisheries Research Program (PFRP).

To better categorize the various types of longline fishing in Hawaii a 7-year set (November 1990-October 1997) of logbook data was subjected to cluster analysis and three clusters were defined on the basis of catches of 12 species. The first cluster was most consistent in its catch composition of mostly blue shark and swordfish. The second cluster was dominated by bigeye tuna and albacore and the third by swordfish and bigeye tuna. The blue shark/swordfish cluster was primarily associated with swordfish-directed and mixed-species-directed fishing, whereas the bigeye tuna/albacore cluster was primarily associated with tuna-directed and mixed-species-directed fishing.

To better understand factors affecting blue shark catches by the Hawaii longline fishery, statistical analyses were conducted using data gathered by NMFS observers from March 1994 through December 1997 and logbook statistics reported by commercial vessels during this period. The first objective was to identify and characterize the statistical relationships between environmental, operational, and temporal factors and blue shark CPUE. This was done by developing a generalized additive model (GAM) and a regression tree model from the fishery observer data. Both models identified a similar suite of predictors of blue shark CPUE and provided complementary interpretations of the data. Both models identified temporal, spatial, and environmental factors as having important effects on blue shark CPUE. An adjusted time series plot revealed no apparent trends in blue shark CPUE and interannual variation in CPUE was not significant over the 4-yr period of study.

Another objective of the statistical study was to estimate the expected blue shark catch on each longline set for the 95% of longline trips on which observers were not deployed, given the prevailing operational, temporal, and environmental conditions. The estimated values were computed by treating the fitted GAM as a 'surrogate observer' and applying it to the operational, environmental, and temporal predictor variables as reported in the logbook records for each set. The estimated catch for each longline set can then be compared with the catch reported in the logbooks to identify possible reporting errors and provide a better understanding of reporting (and under-reporting) of blue shark catches. The results indicated that prediction with a GAM fitted to fishery observer data is a useful fishery monitoring technique.

American Samoa Longline Fishery in 1998 - This fishery had a record year in terms of vessel participation and landings of albacore tuna (the primary target species). Although comparison of logbook with creel survey results showed some significant differences (see below) the WPacFIN program is working with NMFS PIAO, NMFS Enforcement, and the fisheries agency in American Samoa to resolve the problem. The American Samoa longline fishery developed rapidly over the past 4 years. Most vessels in this fishery are small, 20-30 foot *alia*, open steel-hulled catamarans setting 100-300 hooks hauled by hand cranks on one-day trips. Twenty six longliners were active in 1998, taking 1,756 trips (and sets, i.e. one set per trip). Approximately 770,000 hooks were set. Most fishing was within 25 miles of shore. The primary catch was albacore (20,071 caught) with a catch rate of 26.15 per 1,000 hooks. Skipjack was the second most common catch (2.66 per 1,000 hooks) and yellowfin was third (1.81 per 1,000 hooks). All other fish were relatively incidental.

American Samoa Longline Fishery Comparisons of Logbook and Creel Data -Comparisons of 1998 summary data were made between the American Samoa Department of Marine and Wildlife Resource's (DMWR) creel survey and a matched subset of the logbook census data. In terms of "raw" numbers the comparison suggested under-reporting by approximately 30-35%. Comparisons of data on a on a set-by-set basis revealed even greater, unexplainable, and unacceptable, differences between logbooks and creel survey interview forms. Under-reporting may represent mainly the omission of zero or low-catch trips. There was much less difference between summary creel survey and logbook CPUE data which suggests that the two data sets tell a similar story regarding trends in fishery performance and fish availability

These comparisons emphasize the importance of moving the responsibility and capability of collecting, processing, and controlling the quality of the Federal logbook data to the DMWR. Having the data processed locally on a real-time basis will facilitate improving the quality of the data through increased cross-validation, fisherman interactions and feedback, and use of local expertise in resolving data issues. Lab staff will continue to provide technical assistance and provide reports on the status of the fishery.

Workshop on Longline Take Estimation Statistics - A "Workshop on Statistical Methods for Estimating Takes of Sea Turtles and Seabirds in Longline Fisheries," was convened April 15-17, 1998, at the East-West Center, Honolulu, Hawaii to advance the understanding of statistical issues in the estimation of incidental takes of sea turtles and seabirds in longline fisheries. The workshop brought together for the first time NMFS staff and colleagues from foreign fishery agencies directly involved in take estimation problems. Four "case studies" were reviewed involving incidental takes of sea turtles and seabirds, or both. Methods used to estimate take and mortality levels ranged from simple stratified ratio estimators and mixture distribution models to more complex cross-validated regression-trees coupled with bootstrap procedures to estimate Bayesian posterior distributions. Key statistical issues in observer program design and implementation include the deployment of observers on sufficient fishing trips to achieve desired estimator variance; allocation of an observer's available monitoring time at sea in the face of the growing list of competing program objectives (monitoring of gear interactions with turtles, seabirds, or mammals; mitigation compliance; biological sampling of fish; etc.); and frequency of monitoring to achieve a multitude of objectives.

Estimating Longline Takes of Sea Turtles - During fishing operations, sea turtles occasionally become hooked or entangled in the fishing gear. In the Hawaii longline fishery most sea

turtles taken are released alive but affected to an unknown degree by injury and trauma induced by their capture. Mortality resulting from the incidental capture in longline gear is a cause of concern because the affected populations are classified as endangered or threatened under the Endangered Species Act. Under a NMFS Biological Opinion concerning the longline fishery, NMFS is required to monitor the incidental takes and mortality of sea turtles and seek ways to reduce them. The Lab estimates the numbers of turtles taken and killed annually in the fishery, and the results are provided to the NMFS SWR, which monitors the incidental take and mortality in relation to levels authorized for each species under the Biological Opinion.

Annual turtle takes and kills for all turtle species were estimated using a combination of data collected from a small (~5%) sample of longline trips on which NMFS observers were deployed and the daily logbook records reported by longline vessel captains from all fishing trips. For loggerhead sea turtles, the species most frequently involved in interactions with longline gear, the estimates of take were computed in two steps. First, a regression tree technique was applied to the observer data to identify statistically significant predictors of loggerhead take from a multitude of factors describing longline fishing practices and the ocean environment and produce a statistical model. This model was then applied to the logbook records and the total loggerhead take estimated. Uncertainty in the estimates, expressed as 95% confidence bounds, was assessed with a bootstrap technique.

In addition to using more data from a longer time series in1998, the regression tree analysis of loggerhead takes tested the predictive ability of additional factors, including the distances of the fishing location north or south of a series of sea surface isotherms and a series of wind curl factors that could indicate aggregation or dispersal of the surface flotsam that turtles eat. The final, pruned regression tree for loggerhead turtles indicates that the most significant predictor of loggerhead takes was the position of the longline set relative to the 14°C isotherm . Thus the statistical model tracks to some degree the seasonal and inter-annual shifts in the oceanographic regime.

Although the same method was applied to all turtle species encountered in the Hawaii longline fishery, no significant predictors were found for leatherback, olive ridley, or green turtles because the paucity of observed takes of those species means that a factor has to have a very strong effect to be a statistically significant predictor. For these three species, take estimates were computed by simply expanding the takes per set in the observer data by the total number of sets reported in logbook records. Estimates of the number of turtles killed in the fishery are computed from the take estimates, observer data on the condition of turtle takes, and meager published information on kill per take in other longline fisheries. Estimates of post-release survival are expected to be improved as results emerge from the NMFS program to monitor the movements and behavior of turtles hooked and released using sophisticated satellite transmitters.

The Lab is also examining observer and other relevant data for factors that may influence turtle takes and that may suggest possible take mitigation measures. Three factors have been found to be statistically significant for loggerhead takes. These are the location of the fishing operation in relation to the 14°C surface isotherm, the latitude of fishing, and the sum of floatline length and dropper length. No significant factors have yet been found for the other species. This may simply reflect the difficulty of detecting effects in the presence of a high degree of variability and other statistical problems rather than a lack influence by these factors. There has been an expectation that light sticks might attract sea turtles to longline hooks and thereby increase the likelihood of a take.. In the regression tree models, derived from data aggregated over each set, light sticks were not found to be a significant predictor of take. A further analysis was done using more detailed data collected by observers on the proximity of hooked turtles to the nearest light stick and the results showed no effect of light sticks for loggerheads or leatherbacks.

The statistical power to detect the effects of factors on turtle take from the available observer data is reduced by the high degree of confounding of these effects in commercial fishing operations; commercial longline sets are made with very similar combinations of fishing gear variables chosen to maximize the catch of the target fish species. Much greater contrast between these operational factors could be achieved in a controlled longline experiment, using either a research vessel or chartered

commercial longliner. This year a study was conducted to determine the statistical requirements of such experiments. The results suggest that because of the overall rarity of turtle takes and high set-to-set variability of take rate in the Hawaii fishery, controlled longline experiments sufficient to detect even threefold differences in mean take rates between factors may be prohibitively expensive.

Estimating Longline Takes of Albatrosses - The Lab is also responsible for estimating the take of seabirds incidentally caught by the longline fishery. As with sea turtles, annual takes of black-footed and Laysan albatrosses in the longline fishery were estimated with regression tree models. In addition to the multiplicity of factors tested for sea turtles, the albatross analysis included additional predictors, including composite measures of the proximity of longline sets to albatross nesting colonies in the Hawaiian Islands National Wildlife Refuge. These variables took into account differences in colony size and assumed a diminution of effect with distance from a colony. For both albatross species, the estimated regression tree showed the most important predictor of take to be a nest proximity variable.

In addition to providing albatross incidental take estimates, the Lab assisted the Council by estimating the proportion of the total albatross takes that occurs within various oceanic areas in the neighborhood of the albatross nesting colonies. The Council staff used this information as part of a study of possible time-area regulations to mitigate albatross mortality. The regression trees for both albatross species showed that the proximity of fishing location to the nesting colonies is a key predictor of the likelihood of catching albatrosses. Other factors (longitude for black-footed albatross and year for Laysan albatross) are much less important. Operational factors, such as dyeing the bait blue, placing weights on the droplines, and deploying tori lines, have been shown to be significantly reduce albatross interactions (see below), but these factors were not amenable to testing with observer program data.

Honolulu Laboratory staff also provided other scientific support to the Council regarding the longline-albatross interaction issue. Several Laboratory staff participated in the Council's Black-footed Albatross Population Biology Workshop in October 1998 and made substantial contributions to the workshop proceedings and report. This included a comprehensive review of information on black-footed albatross takes in North Pacific gillnet and longline fisheries, including the Hawaii longline fishery. Laboratory scientists also provided information to assist Council staff and a University of Hawaii professor in a study of time-area closure options to reduce the level of longline interactions with albatross species.

Oracle Database and Geographical Information System Development - The Lab is converting from a long established flat file archival system to a modern on-line, relational database using Oracle database software. The goal is to improve access to data and database summaries, not only for Lab researchers but also for the Council and other users. The Pelagic Fisheries Resources Division at the Southwest Fisheries Science Center in La Jolla was the first to develop an enterprise model, and a development team at the Honolulu Laboratory later joined that effort. The design of the database model was heavily influenced by the Oracle Corporation contractors first in La Jolla and then later in Honolulu. These designers followed, as is common in business, the approach of modeling the data collection and standard analyses and report preparation activities, but they primarily used pelagic data sets in the design phase. After some minor revisions, the Honolulu Laboratory Oracle development team was able to get this model working and to enter data into it.

The Lab has also developed capabilities for conducting analyses using geographical information system (GIS) software. Much of the initial work has been directed toward building a library of coastline, bathymetric, and other baseline data for the Hawaiian Islands, American Samoa, Guam, the Northern Mariana Islands, and U.S. territories. In support of essential fish habitat work. Procedures have also been developed for routinely producing maps of the distribution of catches and effort by the Hawaii-based longline fishery linking to data in the Lab's Oracle database.

Web Site Development - Computer programmers and staff members of and the Lab's Fishery Management and Performance Investigation (FMPI) have prepared over 10,000 pages of fisheries statistics and related information for eventual placement on the Lab's web site (http://www.nmfs.hawaii.edu) the WpacFIN site (http://wpacfin.nmfs.hawaii.edu), and the NOAA ship

Townsend Cromwell student page (http://atsea.nmfs.hawaii.edu/). The Lab web site provides fisheries data and information about Lab research. More specific pages are under development. The FMPI page provides access to information on the Federally managed longline, fishery in the western Pacific. The WpacFIN site provides access to separate web pages for the fisheries offices in American Samoa, Guam, and the Northern Mariana Islands, as well as a range of summary statistics for these three areas and Hawaii. The *Townsend Cromwell* student site provides available information about ongoing research cruises, the schedule of future cruises. The site provides an interactive page for students to have their questions about activities and research being conducted on this research vessel answered. WPacFIN and FMPI are the primary sources of fisheries statistics for the central and western Pacific region. This information was traditionally made available through published reports, by FAX request of summary data sets, and similar means. The Internet provides a more convenient method for providing this information for those in the public and other agencies who have access to the worldwide web.

Pelagic Economic Research - Economic research at the Lab over the past 5 years has concentrated on pelagic fishing vessel economics and theoretical and applied research on alternative fishery management regimes. The approach of the economics research and analysis focuses on supporting Council fishery management plans (FMPs). With the demise of the SWR/Southwest Fisheries Science Center socioeconomic research fund in the early 1990s, all quantitative economic research at the Lab has been conducted in cooperation with the JIMAR PFRP. The Hawaii Fleet Industry & Vessel Economics project (HIFIVE) has conducted a range of field investigations on the cost-earnings structure of the Hawaii-based domestic longline fishery as well as the Hawaii small boat pelagic fisheries, including trolling, handline, charter boats, and charter fishing patrons. These studies will collectively provide a comprehensive picture of the economics of pelagic fishing in Hawaii and provide information to decision-makers on the impact of regulations on the performance of fishing businesses, recreational anglers, and seafood consumers.

The HIFIVE Program and has been funded since the PFRP program initiation in 1994 under the co-leadership of the Lab's industry economist. The purpose of this research project has been to provide fishery management information based on the economic characteristics and dynamics of the Hawaii longline and troll-handline and charter fishing fleets, as well as on the seafood markets and clients of the charter-boat fleets. Some thorough field studies have been completed on the economics of operations for longline (1993 base year), small-boat troll (1996 base year), and charter boats (1997 base year) in Hawaii. A cost-earnings study of the charter boats in Hawaii was completed in 1998. A brief study of tuna market dynamics was also initiated in 1998 and will be completed in 1999. A study of charter boat patrons is beginning in 1999 and further analysis of the production dynamics of the longline and small boat sector is proceeding.

For the study on Hawaii charter boat patrons a draft annotated bibliography has been prepared of recreational fishing studies in Hawaii. This bibliography reviews various articles, papers, technical reports, and other manuscripts addressing aspects of Hawaii's noncommercial marine fisheries. The review is intended to meet informational needs of the nascent statewide Recreational Fishing Task Force implemented by the Council toward improved understanding of noncommercial fishing activity and catch reporting in Hawaii's nearshore and offshore waters. Economic and social aspects of the fishery are highlighted, with some attention to its biological aspects. Given broad variation in the kinds of materials examined, some breadth of analytical focus is required. In all cases, the review addresses the research methods and analytical techniques used for each project, definitional problems related to the notion of recreational and other types of fishing, and where evident, some general findings and implications of the research. The work is not a critical review of the materials per se, but rather a set of summaries focusing on topics relevant to the informational needs of the emerging Task Force.

A HIFIVE analysis of the pelagic seafood markets in Hawaii (1994-96 monthly and 1996 weekly data) analyzed the price relationships in the Hawaii pelagic seafood market. Particular attention was paid to examine the factors affecting price variations in the short run, using the Hawaii Division of Aquatic Resources (HDAR) commercial catch and sales report data. The study concluded that seasonal variation in the volume of landings by Hawaii-based vessels is the predominant factor affecting variation in price for the most of the pelagic species, but price variation is less than volume variation. Substitutability

effects are found within certain species groups that have similar end uses. Holidays (Christmas and New Year's) and the number of tourists coming from Asia are also associated with variation in bigeye and yellowfin tuna prices. In addition, the quality of bigeye appears to have a seasonal pattern that is strongly correlated with sea surface temperature, producing in-seasonal variation in bigeye tuna prices.

The Regulatory Flexibility Act of 1996 (RFA) is the primary legislation driving economic analysis in the current period. It allows judicial review of agency assessments concerning the economic impact of regulations on small businesses, non-profit organizations, and local governments. The NMFS Office of Sustainable Fisheries (F/SF) has initiated efforts to revise NMFS guidelines on complying with RFA requirements and the Lab's industry economist participates in that working group. In the meantime, however, F/SF has required a greater degree of specificity in terms of identifying the viable alternatives to be considered by the Council and analyzed under RFA. The PIAO economist has been concentrating on the former, while the Lab has been concentrating on conducting simplified pro forma financial statement analyses for the latter. However the analyses of the regulatory impacts are increasingly based on older cost-earnings information. Present staff and field work resources are simply inadequate to meet the economic data collection requirements of the revised Magnuson-Stevens Act and the RFA requirements. The NMFS socioeconomic initiative has not provided any resources for this kind of work in the central Pacific

The Lab's economist has also undertaken theoretical research on a range of alternative regulatory regimes based on the property-rights approach to fisheries management. Some of this work concerns corporate approaches to commercial fisheries management. Other work, focused on nonprofit corporate approaches for community control of fisheries. These works may be applicable to the Council's community development programs. However, the community development arena may potentially be very politically sensitive.

BIOLOGY AND OCEANOGRAPHY

The mission of the Honolulu Laboratory includes providing scientific support for management decisions on fisheries for tunas, billfishes, and other pelagic highly migratory species (HMS) in the Pacific. The Laboratory conducts pelagic resource stock assessments and the biological and oceanographic research needed to improve stock assessment and management analysis. The Laboratory's findings are provided to the Council and PIAO and are major ingredients of the Council's FMP for pelagics. The Laboratory's research also provides support for multilateral assessment of pelagic resources and the participation of the U.S. in the emerging international arrangements for HMS fishery management in the central and Western Pacific (MHLC) and for scientific cooperation on HMS in the North Pacific (ISC).

The scope of the Laboratory's research is defined by the important issues faced by the Council and the international fisheries community. Currently these include concerns about the status of swordfish targeted by Hawaii's longline fleet and the blue marlin population important to Hawaii's recreational and charter-boat troll fleet. Other issues are the potential impact of longline fisheries, including Hawaii's fishery, on shark populations, the status of tuna populations important to U.S. fisheries and also exploited by foreign fleets, and the populations of other pelagic species about which little is known; e.g., ono, opah, and mahimahi. Much of the Laboratory's biological and oceanographic research is focused on describing biological characteristics that determine their distribution and behavior in a dynamic ocean environment and their availability, catchability and vulnerability to pelagic fishing gear.

Proceedings of the Forty-Ninth Annual Tuna Conference - More than 100 persons participated in the 49th Annual Tuna Conference at Lake Arrowhead California, May 18-21, 1998. Conference proceedings, including 58 abstracts of talks and poster presentations, were distributed at the meeting. The theme of the 1998 conference was Changing Management Paradigms, and a highlight of the meeting was a panel discussion on Meeting Magnusson-Stevens Fishery Conservation and Management Act (MSFMCA) Mandates in Tuna Fisheries. Other special sessions included a special celebration of the Honolulu Laboratory's 50th Anniversary and a mini-symposium with presentations on

the population genetics of tunas and billfishes. The 50 years of tuna research celebrated at the meeting represented an historical milestone and largely encompassed the history of tuna fishery biology and oceanography in the Pacific. The opportunity for scientific feedback on the MSFMCA mandates and the opportunity to exchange views with headquarters staff were very useful. The genetics session made a strong impression on a largely skeptical audience that real progress is finally being made in defining billfish stock structure for management purposes.

Comprehensive Research Program on Pacific Bigeye Tuna - Honolulu Laboratory staff were major contributors to a meeting hosted by the JIMAR PFRP November 9-11, 1998. The purpose of this meeting was to develop a prospectus for a coordinated international research plan to address scientific uncertainties regarding bigeye tuna populations in the Pacific Ocean. This resource is conservatively estimated to be worth in excess of $1 billion annually. The meeting, held in Honolulu, was also attended by scientists and managers from institutions and countries spanning the Pacific basin. Topics included regional and basin-scale efforts to examine movement, behavior, and physiology of bigeye tunas and monitoring of their habitat using a combination of advanced electronic archival tags, conventional tags, acoustic tracking, oceanographic moorings, and remote sensing technologies. Recent technological advances in electronic archival tags and pop-up tags and their role in upcoming research efforts were discussed in considerable detail. The meetings were concluded with unanimous agreement to conduct a coordinated international research effort on bigeye tunas.

ISC Swordfish Working Group - A meeting of the Swordfish Working Group (SFWG) of the ISC was hosted by the Lab in Honolulu January 15-16, 1999. Twenty-seven persons participated, including, scientists from ISC member countries Japan, Mexico, and the United States; National Taiwan University; the Overseas Fisheries Development Council of the People's Republic of China; the Inter-American Tropical Tuna Commission; the Secretariat of the Pacific Community; and other organizations. The Lab's director, R. Michael Laurs, chaired the meeting which was held to review information concerning swordfish resources in the ISC region of interest, including fishery statistics, the status of swordfish stocks, and progress in biological and oceanographic research in support of swordfish stock assessment. Ten working papers were presented and discussed.

Despite considerable progress in research on swordfish biology and fishery oceanography and extensive sharing of historical fishery statistics for the purpose of swordfish stock assessment, provisional stock assessments presented by SFWG scientists were inconclusive (below). The degree of exploitation and condition of the resource could not be determined and remain unknown. However, the working group noted that the standardized swordfish catch-per-unit-of-effort (CPUE) in the Japanese longline fishery has been stable at least since the mid-1970s, by which time Japanese longline fishing effort was broadly distributed over the region, and has been directly and linearly related to the total swordfish catch. Assuming that CPUE reflects swordfish abundance, these facts are consistent with a low exploitation rate. The SFWG identified several critical needs in fishery monitoring and biological and oceanographic research to improve models of swordfish population dynamics and reduce uncertainties in stock assessments.

Swordfish Stock Assessment - In 1988 a data exchange with Japanese colleagues was arranged with the long-term aim to develop and apply assessment models that could address the complex spatial dynamics of swordfish populations in the Pacific and of the various fisheries that exploit them. A preliminary stock assessment using more traditional, spatially aggregated models, was presented at the SFWG meeting (above). Two production models were developed and applied to combine Japanese and Hawaiian longline catch and effort data for the North Pacific west of 135°E and north of 15°N. Allowance was made for catch by Taiwanese and Korean vessels for which complete effort data were lacking. One model was a traditional Pella-Tomlinson production model with a non-traditional feature of allowing constrained variation in time of catchability and carrying capacity. The second model partitioned fish production into parameters of recruitment and natural mortality with constrained variation in catchability and recruitment. Both models gave equivocal results in that with slight changes in weighting factors they converged to different scenarios varying from high population turnover with scant effect of the fisheries to slow turnover with large effect of the fisheries, though no scenarios

implied impending population collapse. The most interesting result was that these relatively simple models gave indications of difficulty in dealing with the changing spatial extent of the fisheries.

Swordfish Fishery Simulation Model - In contrast to several tuna species, relatively little is known about swordfish, and the associated time series of catch and effort statistics tend to be characterized by an even greater level of uncertainty and incompleteness. This uncertainty precludes fishery agencies from relying on conventional stock status indicators, so there is a need to identify alternative reference points for management purposes. To design assessment methods that make optimal use of deficient data sets, and determine the reliability and cost-effectiveness of alternative indicators, one usually has to compare the performance of conventional and new analytical tools using known benchmarks.

With this approach in mind, an operational model is being constructed to help evaluate the performance of stock assessment and fishery management procedures in this 'data poor' context. The model is designed to mimic key aspects of the dynamics of pelagic fisheries, as well as the fishery monitoring and management processes. The current version of the model is primarily designed to generate time series of fishery or stock attributes given a set of input parameter values, and user-specified sampling patterns and observation error. The model incorporates key features of aged structured and length-based models, and already accounts for the processes of growth, reproduction, mortality, recruitment, and exploitation. Work is in progress to incorporate movement, species interactions, fleet dynamics and environmental effects. The model will be improved as new information is obtained though ongoing studies and data collection programs.

Swordfish Growth Studies -Age and growth studies of swordfish continue to utilize the information provided by "annuli" (bands formed once yearly) on cross sections of anal fin rays. Preparation and analyses of anal fin ray cross sections have continued for swordfish spanning the entire range of body sizes exploited by the Hawaii-based pelagic longline fishery. First readings and measurements have now been completed for a cumulative total of 1,400 fish. A substudy to characterize within- and between-reader ageing errors has been initiated, as have specimen exchanges with other institutions to distinguish possible differences in ageing protocols from potential variations in growth rates among North Pacific regions (e.g., for swordfish caught by the Taiwan-, Mexico-, and Hawaii-based longline fisheries).

A study complementary to the primary approach of estimating the ages of large numbers of swordfish using fin rays, has been an evaluation of the age record provided by earstones (otolith sagittae). A comparison of the estimated body sizes at age 365 days as indicated by daily growth increments on earstones with size at age-1 year as indicated from annuli on fin rays indicated lengths of 98 cm EFL (95% confidence limits, CI = 93-103 cm EFL) based on earstones and 95 cm EFL (95% CI = 92-98 cm EFL) based on fin rays. Limited (n = 3) recaptures of tagged yearling fish (see tag report below) at liberty for 1, 2 and 4 years further indicate that our characterization of length-at-age is reasonable for fish of this size and age range. Subsequent growth rate characterizations will need to fit more realistic models for the sexes separately. These models and sex-specific age-at-maturity distributions are important elements of future age-structured stock assessments.

Swordfish Reproduction and Sex Identification Studies - Swordfish gonads collected by NMFS, SWR observers aboard commercial vessels of the Hawaii-based longline fishery during 1994-97 are being examined to characterize size-specific batch fecundities of female fish. Together with estimates of spawning frequency based on incidence of post-ovulatory follicles, batch fecundities might prove useful for estimating egg production in egg-per-recruit analyses. Analysis of size composition data for known-sex swordfish based on these same gonad collections suggest that sex ratio can be adequately predicted from body length for fish between about 100 and 220 cm EFL. A spatially and temporally refined version of this mathematical relationship might be applicable to the entire Hawaii-based longline fishery. If so, data on body size could be used as a morphological proxy for sex that would allow swordfish landings data to be partitioned by sex based on size composition. Sex-specific catch data are necessary if the power of sex-specific age-at-maturity and growth rate data are to be fully utilized in future age-structured stock assessments.

Development of a chemical sex marker for swordfish continued. A swordfish vitellogenin (VTG) assay has been successfully developed in collaboration with by Dr. Nancy Denslow, University of Florida, Gainesville, which has proven capable of recognizing the presence of VTG in (and hence the sex of) muscle tissues of known-sex individuals of several other fish species, and cold storage of tissues for several weeks does not appreciably reduce the sensitivity of the assay. The assay is now being evaluated for its ability to distinguish between the muscle tissues of immature and mature male and female swordfish. Practical application of the assay would likely cost about US$15 per fish. If the assay proves capable of consistently identifying the sex of individuals, its greatest value may lie in the ability to identify the sex of large swordfish individuals from muscle biopsies when tagged and to aid in the subsequent interpretation of movements and other activity data that surely differ among different-sized swordfish of the two sexes. Collection of tissue specimens was also initiated for a PFRP project in collaboration with the Hawaii Institute of Marine Biology (HIMB) to develop a genetic sex marker for swordfish as a possible alternative to the VTG assay.

Swordfish Length-Weight Interrelations Study - Relationships among commonly used length and weight metrics were described for swordfish from the central North Pacific were described using swordfish sampled by NMFS, SWR observers aboard commercial vessels of the Hawaii-based longline fishery during 1994-97 and caught on research cruises of *Townsend Cromwell* during 1991-97. The described relationship provided previously unavailable information, required for pending stock assessments of swordfish in the Pacific. Findings further allowed interconversion of length and weight metrics for comparison with swordfish landings on the U.S. Atlantic seaboard and elsewhere. Sex had a statistically significant but minor effect on weight-at-length. In general for both sexes, weight-at-length averaged nearly 10% greater during December-March than July-September--i.e., prior to, versus following, the peak April-June spawning period.

Conventional Tagging Studies--The tagging of swordfish and other pelagic fishes continued this past year, aided by both contracted and cooperative arrangements with commercial longliners, and resulted in newly tagged totals of 93 swordfish, 37 tunas, and 2 marlins. Fifteen sharks of 3 species (10 blue, 2 mako, 3 bigeye thresher) were also tagged in support of the shark research program of the Pelagic Resources Division of the National Research Institute of Far Seas Fisheries (NRIFSIF), Japan. Ninety-two sharks have been tagged and released within the region of the Hawaii-based fishery since the shark tagging program was begun in 1997.

Since the beginning of the Honolulu Laboratory's pelagic fish tagging program in 1990, cumulative totals of 556 swordfish, 155 marlins (blue and striped marlin, shortbill spearfish) and 218 tunas (albacore, bigeye and yellowfin tunas) have been tagged. To date there have been 46 tag recoveries (3 swordfish, 8 blue and 30 striped marlin, 5 bigeye tuna) by the Hawaii-based pelagic longline fishery and United Fishing Agency, Honolulu. Two additional swordfish recaptures have been made by other fisheries (Japanese longliner, California drift netter). The Hawaii recreational fishery has recovered about 20 tagged billfish (14 blue and 56 striped marlin), and Hawaii-based longliners recently recovered 4 tagged blue sharks. Three of the five swordfish recaptures have provided some of the growth-at-liberty data needed to validate growth rate estimates (above).

Archival Tagging Project - To understand harvest impacts and interactions among fisheries across the Pacific, data is needed on fish migration patterns and habitat. The development of archival tags provides a new tool for studying movement and habitat choices over long periods. The Lab is conducting an archival tagging project on swordfish and bigeye tuna in collaboration with the JIMAR PFRP, and the Commonwealth Scientific & Industrial Research Organization (CSIRO) of Australia. The original objective of the work was to tag swordfish with new pop-up geopostion archiving, satellite transmitting tags. However delays in developing this technology and concerns about possible deleterious effects of Hawaii's growing offshore handline fishery for bigeye tuna was the impetus for deploying conventional archival tags in this fishery. Bigeye tuna have a higher recapture rate than swordfish, and recapture is required for conventional archival tag data recovery. To date, 50 conventionalarchival tags have been deployed off the Kona coast of Hawaii and at Cross Seamount.

In July, 1998, a bigeye tuna carrying an intramuscularly implanted archival tag was recaptured after 85 days at liberty. Ambient light measurements by the tag were expected to provide an estimate of longitude (from local noon) and latitude (from day length) of the tuna's swimming location. Unfortunately because the fish dove so deep during the day (> 450 m), ambient light levels were below the sensitivity of the tag's light detector. However, the fish's daily behaviors were found to be highly repetitive. It remained at 20-90 m at night and dove to 350-500 m each day. This pattern became regular and obvious approximately 6 days after the tuna was released. It was therefore possible to use the fish's diving behavior to estimate dawn and sunset times and thus calculate its position. From these data it appears that the fish remained adjacent to the west coast of the Island of Hawaii for the entire 85 days. During this period the tuna's latitudinal movement ranged only from approximately 15°N to 20°N, and longitudinal movement from 155°W to 158°W. Depths occupied by the tuna during the night were found to be linked to the lunar cycle. During full moon periods the fish stayed around 90 m, whereas during the new moon it came to within 20 m of the sea surface. An understanding of such behavior will help explain the demonstrated correlation between longline CPUE and moon phase. Two more archivally tagged bigeye from this study have recently been recaptured, and the first pop-up tag was deployed with sucessful recovery of data via satellite.

Blue Marlin Research - Concerns about the status of blue marlin and other marlin species have been expressed by management agencies and recreational fishing constituents throughout the Pacific. At the recent ISC meeting it was agreed that the U.S. would take the lead on an ISC Marlin Working Group (MWG). The Lab will organize this group in cooperation with the SPC's Billfish and Bycatch Research Group and other collaborating scientists and agencies. As its first priority, the group will assess the status of blue marlin, taking into account recent analyses of stock trends underway at the National Research Institute of Far Seas Fisheries (NRIFSF) in Shimizu, Japan, and a stock assessment recently conducted by the Inter-American Tropical Tuna Commission (IATTC). The IATTC assessment was based on different methods and assumptions from those employed by NRIFSF scientists. The results of the two analyses conflict, one showing an increasing trend in the blue marlin abundance and the other a decreasing trend over the past two decades. The MWG will review both studies, attempt resolve the differences, and develop alternative approaches as appropriate.

Blue Shark Research - The Council's Pelagics FMP includes sharks, yet there is an insufficient understanding of shark population dynamics and biology to support a meaningful analysis of fishery impacts on sharks and shark management policies. Therefore the Lab has undertaken several studies on shark fishery statistics, biology, and stock assessment with emphasis on the blue shark, which makes up over 95 percent of the Hawaii longline shark catch.

The Lab established a cooperative research program with scientists at the NRIFSF in 1997 to exchange information, fishery data, and expertise pertinent to shark assessment and biology. During 1998, by Dr. Hideki Nakano, a shark specialist with the NRIFSF made a 3-month visit to the Lab resulting in several notable accomplishments. A synopsis of biological data on the blue shark was drafted for publication in a peer-reviewed journal. This synopsis is global in scope and covers blue shark systematics, biology and life history, population status, and exploitation with publication expected in 1999. Significant progress was also made in the translation from Japanese to English of Dr. Nakano's Ph.D. dissertation on blue sharks. Joint HL-NRIFSF research on blue shark population assessment in the North Pacific has begun with the exchange of relevant historical fishery data. Progress has also been made in an HL-NRIFSF project to tag and release blue sharks on an opportunistic basis from commercial longline vessels and research vessels; several sharks tagged in the Japanese longline fishery have been recaptured in the Hawaii fishery, and vice versa.

An issue of particular importance is the practice of shark finning: processing a shark by removing and retaining its economically valuable fins and discarding the rest of the fish. The NMFS statistics show that the fishery catches about 100,000 sharks each year, of which about 95% are blue shark. In the early part of this decade, most of the sharks were caught on fishing trips targeting swordfish, but in recent years the majority of sharks have been taken on trips in which the vessel targeted tuna or targeted a mix of tuna and swordfish. A trend toward increased utilization of shark is evident, with the overall percentage of shark catches processed by finning rising from 3% in 1991 to 60% in

1998. The highest rate of finning occurs on trips targeting tuna. Analysis of blue shark fishery statistics in the Hawaii longline fishery provided GAM and regression tree models useful in estimating logbook accuracy and in examining blue shark CPUE time series (see fishery monitoring, above). These studies indicate no decline in standardized blue shark CPUE.

Tuna Physiology and Behavioral Ecology- Population assessments based on CPUE data often assume catchability of the target species is constant; i.e., that changes in CPUE primarily reflect changes in overall fish abundance. However, the physiological capabilities of pelagic species determine their habitat, and affect CPUE. Accurate population assessments therefore depend on the ability to differentiate CPUE variations linked to abundance from those caused by other factors, such as changes in oceanographic conditions that in turn affect habitat and vulnerability to fishing gear. This is the focus of research conducted at the Lab's Kewalo Research Facility. The Kewalo research complements field studies of the movements and habitat of fish in the open ocean conducted using both ultrasonic telemetry and archival tags. Much of this work has been supported by a cooperative project between the Lab and the JIMAR PFRP

In a Lab study just published in *Marine Biology* the horizontal movement and depth distribution of adult yellowfin tuna near the Hawaiian Islands was recorded using ultrasonic telemetry. The study measured the horizontal and vertical movements of five adult yellowfin tuna (estimated body mass 64-93 kg), while simultaneously gathering data on oceanographic conditions and currents. Fish movements were recorded by means of ultrasonic depth sensitive transmitters. Depth-temperature and depth-oxygen profiles were measured with vertical conductivity-temperature-depth (CTD) casts and the current velocity field was surveyed using an acoustic Doppler current profiler (ADCP).

Adult yellowfin tuna were found to spend approximately 60-80% of their time in or immediately below the relatively uniform temperature surface layer (i.e., above 100 m), a behavior pattern similar to that previously reported for juvenile yellowfin tuna, blue marlin, and striped marlin tracked in the same area. In all three species, maximum swimming depths appeared limited by water temperatures 8°C colder than the surface layer. Therefore, neither large body mass, nor the ability to maintain elevated swimming muscle temperatures due to the presence of vascular counter-current heat exchangers in tunas, appears to permit greater vertical mobility, or the ability to remain for extended periods below the thermocline. In those areas where the decrease in oxygen with depth is not limiting, the vertical movements of yellowfin tuna, blue and striped marlin all appear to be restricted by the effects of water temperature on cardiac muscle function, as indicated by physiological experiments conducted at the Kewalo Facitlity. Like juvenile yellowfin tuna, but unlike blue and striped marlin, adult yellowfin tuna remained within 18.5 km of the coast and became associated with floating objects, including anchored fish aggregating devices (FADs) and the tracking vessel. Like juvenile yellowfin tuna, large adult yellowfin repeatedly revisit the same FAD, and appeared able to navigate precisely between FADs that are up to 18 km apart. The median speed over ground ranged from 72-154 cm s^{-1}. Neither speed nor direction was found to be strongly influenced by currents.

Previously unsuspected influence of temperature on heart function resulting from studies at the Kewalo Research Facility and the resulting limiting effect of ambient temperature on depth distribution have important implications for stock assessment models capable of accounting for depth variation in vulnerability to fishing gear (e.g., current IATTC and SPC population assessment models for blue marlin, bigeye and yellowfin tunas). Current efforts are directed at understanding the physiological basis for the bigeye tuna's tremendous vertical mobility, in comparison to the relatively limited vertical mobility other tuna and billfish species. Subject to additional funding, the Lab's physiological and behavioral research may be expanded to address questions of post-release mortality of marlin, tuna and sharks, and to develop physiological or biochemical indices of vital rates useful for developing initial stock status estimates for little studied incidental species like opah (moonfish), ono (wahoo), and monchong (pomfret).

Research to Reduce Longline Fishing Gear-Seabird Interactions - NMFS and the Western Pacific Regional Fishery Management Council (WPRFMC) are concerned that the longline-related mortality of albatross may threaten the well-being of albatross populations that nest mainly in the

Northwestern Hawaiian Islands. Based on fishery observer data collected by NMFS, the Hawaii-based fishery may be killing several thousands of these birds each year.

In February the Lab completed a very successful month-long research cruise on the *Townsend Cromwell* that tested various methods of keeping seabirds from being hooked in commercial longline fishing operations. The cruise tested the tori line (a kind of "scarecrow") as well as weighted bait, and blue-dyed bait for their efficacy in deterring birds from being caught in the longline fishery. Hookings by the Hawaii fishery occur mostly in the swordfish fishery north of the archipelago where albatross and swordfish are most abundant. In the swordfish fishery, the common practice of deploying longline gear after dark greatly reduces seabird contacts with baited hooks, but occasional hookings do cause deaths of black-footed and Laysan albatross.

Results of the study showed that all three deterrents greatly reduced the number of times albatross came in contact with longline baits. The advantage of using the *Townsend Cromwell* for this research was that fishing operations could be controlled to improve the opportunities for observation, comparison, and statistical analysis. For example, by setting gear in daylight the scientists greatly increased the number of bird interactions with the gear in the presence and absence of each deterrent method. No birds were hooked during the NMFS research cruise, even during control portions because large safety pins (net pins) were used instead of hooks. When birds swallowed these "safety hooks" they easily regurgitated them. Scientistst observed all setting and hauling operations, recording the numbers of each species attempting to reach baited lines (chasing, landing, or diving) and the numbers contacting and swallowing baits.

Cruise results indicated that all of the deterrents substantially reduced bird contacts with baits duirng setting. Albatross are most often killed by longlines during setting because if they are hooked or entangled they sink with the gear and are drowned, whereas if they are hooked during the haulback they can be released Blue-dyed bait and weighted bait each reduced the number of times birds contacted baits by about 90%. The tori line reduced bird contact with baits by about 70%.

No short-tailed albatross were seen during the hundreds of hours spent observing thousands of birds. Short-tailed albatross have the smallest population of any albatrosses in the North Pacific, and they are very rare in Hawaiian waters. Boobies, shearwaters, frigate birds, terns, and petrels were identified in addition to albatrosses but not one of these other birds ever contacted the baited lines. Black-footed albatross plumage changes with age. Less than one-year-old birds have uniformly dark-brown plumage. After their first year they acquire white-tipped tail coverts. Old birds may reach 40 years in age. During haulback, when birds approached the vessel closely, Lab scientists recorded that more than half of the black-footed albatross had juvenile plumage, and that about 80% of the black-footed albatross that took baits off the lines were these young birds. This result supports the idea that fishery-related mortality represents mostly young, inexperienced birds.

Oceanographic Research on the Habitat of Longline Target Species - Developing an understanding of swordfish habitat is a major research focus at the Lab. Assessment of swordfish distribution and abundance patterns based on fishery data together with environmental information gathered from shipboard surveys (in collaboration with University of Hawaii oceanographers) and satellite remote sensing has led to an oceanographic characterization of this habitat. During the peak winter-spring fishing season, swordfish occupy a region nominally referred to as the Subtropical Frontal Zone (STFZ). Specifically, this region is bound by two distinct large scale convergent fronts: the subtropical Winter Front to the south and the Subtropical Front to the north, each with unique biological implications.

The Winter Front is climatologically positioned between latitudes 28°N and 30°N during the months of January to April after which the front rapidly migrates northward with increasing insolation. The 20°C and 35.0 surface isotherm and isohaline, respectively, are usually seen embedded in the frontal gradients and are readily detectable by in situ and satellite sensors. Vertically, the thermocline shoals to a depth of about 70-80 m. Nutrients are transported into the euphotic zone, and production and standing stock of phytoplankton sharply increase at the subsurface chlorophyll maximum. Shoaling of the

thermocline is believed to physically concentrate swordfish and their prey closer to the ocean surface and thus more vulnerable to surface longline gear. To the north, the Subtropical Front (17°C surface isotherm, 34.8 isohaline) is typically positioned between latitudes 31°N and 33°N during January to April and also rapidly migrates northward thereafter. A surface chlorophyll front exhibiting a twofold increase in concentration is also normally associated with this front and is readily monitored by the SeaWiFS ocean color satellite. Dynamically, the increase in chlorophyll can be ascribed to the weakened vertical density structure and facilitated flux of nutrients into the surface waters. The dynamical oceanography of the Subtropical Frontal Zone is captured in the measurement of sea level height (SLH) from the Topex/Poseidon satellite altimeter, and a close relationship between the environment and fishery dynamics is readily observed. SLH measurements are used to develop a Subtropical Front environmental index (SFI) to help interpret fishery performance and CPUE; refinements to the SFI continue.

A series of STFZ research cruises by the Honolulu Laboratory have been undertaken to investigate and monitor the physical and biological oceanography of the Subtropical Front and adjacent water masses north of Hawaii in April-May each year. Shipboard in situ observations and data collection are supported with near real-time satellite sea level height (Topex), sea surface temperature (AVHRR, GOES), and ocean color (SeaWiFS) information relayed to the vessel at sea by the Hawaii CoastWatch Program at the Honolulu Laboratory. The information provided by the surveys serves several purposes: (1) it substantially advances our understanding of the oceanographic dynamics associated with the STFZ ecosystem and the coupled physical-biological relationships that exist at these ecotones, (2) it strengthens our assessment of the environment of the fishing ground and the development of ecological indicators that may be used to monitor biological conditions at fishery-critical habitats and to identify key parameters for interpreting fishery performance, and (3) it provides groundtruthing and subsurface interpretation for several satellite tools (e.g., altimetry, ocean color) used to remotely monitor the condition of the fishing ground. Annual changes in catch rates in the fishery may be due to changes in resource abundance or changes in the environment at the grounds, or both. Monitoring the region with both satellite remote sensing and shipboard measurements of coincident surface and subsurface hydrography allows addressing the role of environmental variation as a factor in changes observed in fishery performance.

In 1999, the Winter Front (WF) that is typically associated with commercial swordfish fishing activity was positioned at 31.5°N latitude, more than 200 nmi farther north than found the prior year along the same line and at any time during the four years of surveys. Weaker gradients in thermocline properties and substantially lower chlorophyll concentrations (half of 1998 levels) in the subsurface maximum were also observed at the WF in 1999. Consistent with satellite information provided by Coastwatch, the Subtropical Front and surface chlorophyll front had already undergone rapid migration to the north and were never encountered on the 1999 cruise.

A new research initiative under the JIMAR PFRP is underway to study the role of the environment on bigeye tuna aggregation and vulnerability to fishing. The study will use the combined oceanographic information acquired from satellite (i.e., altimetry, temperature, ocean color), moored, and shipboard platforms together with commercial and research fishery data for the assessment. The mooring will be deployed about 185 km southwest of the island of Niihau at latitude 20°36.0'N, longitude 161°34.2'W. This location was selected based on bigeye tuna CPUE, variability of CPUE, proximity to TOPEX altimetric satellite crossover paths, variability of oceanographic structure, and linkages to other PRFP projects. The BIGEYE mooring will describe the habitat of bigeye tuna by providing a time series of the vertical structure of temperature and velocity in the upper ocean.

Investigation of Loggerhead Turtle Forage Habitat - There is concern about incidental catches of loggerhead turtles in the Hawaii-based longline fishery for swordfish. To learn more about the turtle forage habitat in the region of the swordfish fishery satellite remote sensing data of sea surface temperature (SST), chlorophyll, and geostrophic currents were used to describe the environment at and around the daily positions of nine loggerhead turtles tracked by satellite telemetry during 1997 and 1998. The results showed that all nine loggerheads traveled westward along two convergent oceanic fronts, against eastward prevailing currents. Six of the turtles associated with a front characterized by 17°C SST, surface chlorophyll of about 0.2 mg/m^3, and eastward geostrophic current of about 4 cm/s. This front is easily seen from satellite remote sensing of ocean color. Interannual variation in the movement of this front appears to alter turtle migration The other three turtles associated with a front with 20°C SST,

surface chlorophyll of about 0.1 mg/m^3, and eastward geostrophic of about 7 cm/s. These results explain why incidental catch rates of loggerheads in the Hawaii longline fishery are highest when gear is set at 17°C and 20°C SST. Further, from the seasonal distribution of longline effort relative to these fronts, it appears that the surface longline fishing ground lies largely between these two fronts during the first quarter and well to the south of the 17°C front but including the 20°C front in the second quarter. The turtle catch rates in the longline fishery are highest at the 17°C front, so an area or seasonal closure which separates the longline fishery from this front might effectively reduce interactions with turtles. A manuscript resulting from this work is in press at *Fisheries Oceanography*.

Physical and Biological Impacts of El Niño and La Niña - Analyses of long time series of sea surface temperature (SST) over the North Pacific show that during El Niño, SST in the central North Pacific is cooler than average while SST in the eastern equatorial Pacific is warmer than average. During the La Niña, SST in the central North Pacific is warmer than average while the eastern equatorial Pacific is cooler than average. Thus relative to SST, the central Pacific and eastern North Pacific appear to respond in the opposite direction. To further investigate impacts of El Niño and La Niña to the northern portion of the Hawaiian Archipelago, satellite remote sensed chlorophyll from SeaWiFs and sea surface height from the altimeter aboard TOPEX/Poseidon were used to describe the changes during the winter and spring of 1998 (El Niño) and 1999 (La Niña). These investigations all indicate that both the physical and biological response to El Niño/La Niña in the northern portion of the Hawaiian Archipelago is opposite from the classical pattern observed in the eastern tropical Pacific. While the El Niño/La Niña impacts in the northern portion of the Hawaiian Archipelago are not as extreme as found in the eastern tropical Pacific, they may still have ecosystem impacts.

Acoustic Doppler Current Profiler (ACDP) - An ADCP was installed aboard *Townsend Cromwell* in 1987 to collect data on ocean currents along each of the ship's cruise tracks. The ADCP measures ocean currents in the upper 250 meters of the ocean by transmitting acoustic signals into the water. The sound reflects off particles and zooplankton drifting with the ocean currents back to transducers aboard the ship. The frequency of the returned signals is shifted slightly depending on whether the particles are moving toward or away from the ship's transducers, from which profiles of the speed and direction of the ocean currents can be computed. In 1998, Honolulu Laboratory oceanographers began processing the ADCP data archive from the present backward in time. To date, 59 cruises or 118 ADCP transects along the northwestern Hawaiian Islands (NWHI) have been processed dating back to 1991. These provide a time series, which oceanographers are using to examine the variability of the NWHI ocean currents over monthly, seasonal, interannual, and decadal time scales.

Hawaiian Ocean Mixing Experiment - The Lab is participating with investigators from five academic institutions on the Hawaiian Ocean Mixing Experiment (HOME), an integrated program funded by the National Science Foundation to study the role of tidally induced topographic mixing in maintaining the large scale thermohaline circulation of the world's oceans. Observed mixing rates in the pelagic ocean are an order of magnitude less than that required to maintain the large scale circulation. Recent observations suggest instead that most of the oceanic mixing occurs near significant topographic features, such as the Hawaiian Ridge. The challenge is to identify the mechanisms which are active over a sufficient space-time domain as to have a global impact.Through this collaboration the Lab will have access to unique, high quality data sets and state-of-the-art instrumentation to examine the spatial and temporal variability of oceanographic conditions along the Hawaiian Ridge. These data sets will be utilized to examine the complex physical and biological interactions associated with the topography of the ridge. This will provide an improved understanding of these dynamic ecosystems and an improved ability to manage the fishery resources and protected species of the Hawaiian Archipelago.

1998 PUBLICATIONS (Southwest fisheries science center, Honolulu laboratory)

Hamilton, Marcia.
1998. A system for classifying small boat fishermen in Hawaii. Marine Resource Economics 13:289-291.

He, X., and M. Laurs (Synopsis).
1998. Bycatch, discards, finning, and economic value of blue shark in the Hawaii based longline fishery. *In* N. A. Gibble, G. McPherson, and B. Lane (eds.), Shark Management and Conservation: Proceedings from the Sharks and Man Workshop of the Second World Fisheries Congress, Brisbane, Australia, August 2, 1996, p. 88-91. Conference and Workshop Series QC98001, Department of Primary Industries, Queensland.

Leung, S., J. Muraoka, S. T. Nakamoto, and S. G. Pooley.
1998. Evaluating fisheries management options in Hawaii using analytic hierarchy process (AHP), Fish. Res. 36:171-183.

McKinnell, S., and M. P. Seki.
1998. Shark bycatch in the Japanese high seas squid driftnet fishery in the North Pacific Ocean. Fish. Res. 39:127-138.Mundy, B. C., and A. R. Everson.
1998. Western Pacific oceanic report. *In* Mac, M. J, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran (eds.), Status and trends of the nation's biological resources, Vol. 2, p. 824-844. U.S. Department of the Interior, U. S. Geological Survey, Reston, VA.

Parrish, F. A., and R. S. Goto.
1997. Patterns of insular shark dynamics based on fishery bycatch and lifeguard surveillance at Oahu, Hawaii 1983-1992. Bull. Mar. Sci. 61(3):763-777.

Pooley, S. G.
1998. Fisheries. *In* S. P. Juvik and J. O. Juvik (eds.), Atlas of Hawai'i, Department of Geography, 3d edition, p. 252-254. University of Hawaii at Hilo. University Press.

Pooley, S. G. in collaboration with the NMFS Limited Access Working Group.
1998. Issues and options in designing and implementing limited access programs in marine fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-252, 73 p.

Skillman, R. A., P. Kleiber.
1998. Estimation of sea turtle take and mortality in the Hawai'i-based longline fishery, 1994-96. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-257, 52 p.

Administrative Reports

Hamm, D. C.
1998. Central Western Pacific Fishery Information Network (WPACFIN) three-year plan. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-98-11, 38 p.

Hamm, D. C., N. T. S. Chan, and M. M. C. Quach.
1998. Fishery statistics of the western Pacific, Volume XIII. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-98-04, 200 p.

Kleiber, Pierre.
1998. Estimating annual takes and kills of sea turtles by the Hawaiian longline fishery, 1991-97, from observer program and logbook data. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Cent. Admin. Rep. H-98-08, 15 p.

Abstracts

Boggs, C. H., J. F. Kitchell.
1998. ECOSIM modeling of pelagic fishery impacts. [Abstr.] Working document prepared for the American Institute of Fishery Research Biologists sponsored symposium for the American Fisheries Society Meeting (128th annual meeting), Hartford, Connecticut, August 23-27, 1998.

Humphreys, J. R.
1998. Progress in ageing juvenile Pacific swordfish using sagittal otoliths. [Abstr.] For presentation at the 2nd International Symposium on Fish Otolith Research and Application, Bergen, Norway, 20-25 June 1998.

Ito, R. Y.
1998. Catch of albacore by the Hawaii-based longline fishery. [Abstr.] Working document prepared for the 15th North Pacific Albacore Workshop, Nanaimo, British Columbia, Canada, 1997.

Kitchell, J. F., C. H. Boggs, X. He, and C. J. Walters.
1998. Keystone predators in the central Pacific. [Abstract] Paper presented at the Proceedings of the Wakefield Symposium, "Ecosystem Considerations in Fisheries Management," Anchorage, Alaska, September 1998.

Leonard, C. L., R. R. Bidigare, N. L. Ash, and M. P. Seki.
1998. Mesoscale chlorophyll variations in the North Pacific as revealed by shipboard and satellite measurements. [Abstr.] For presentation at the Ocean Optics XIV Meeting, 10-13 November 1998, Kailua-Kona, Hawaii.

Appendix 8

The Pelagic Fisheries Research Program

Introduction

The Pelagic Fisheries Research Program (PFRP) was established in 1992 after the Magnuson Fishery Conservation and Management Act (1976) was amended to include"highly migratory fish". This amendment greatly increased the responsibilities of the Western Pacific Regional Fishery Management Council (WPRFMC or Council) which is mandated to manage fisheries in the Western Pacific region. The PFRP was created to provide scientific information on pelagic fisheries to the Council for use in development of fisheries management policies.

The geographic area encompassed by PFRP studies include the entire WPRFMC area: American Samoa, Guam, Hawaii, Commonwealth of the Northern Mariana Islands, and other U.S. Pacific territories (altogether approximately 1.5 million square miles). The PFRP is located at the Joint Institute for Marine and Atmospheric Research (JIMAR), under the University of Hawaii's School of Ocean and Earth Science and Technology (SOEST). The first PRFP projects were established in late 1993, and work on these projects began in 1994. In order for the Council to determine "optimum use" of these valuable fishery resources, information is required from a broad spectrum of research disciplines, e.g., biology, genetics, statistics, socio-cultural. The PRFP has funded more than 30 research projects and solicits for new research proposals as federal funding permits. Most project investigators are affiliated with regional research institutes, such as the National Marine Fisheries Service (NMFS), Secretariat of the Pacific Community (SPC), and other universities.

1998-1999 Overview

The FY1999 appropriation for Pacific tuna management was the same as for FY1998. This level of funding combined with savings from projects that were completed in FY1998 enabled the Program to conduct a proposal solicitation and fund seven new projects. Funding for most of the new projects is expected to become available to the University in August.

Output by PFRP affiliated scientists remains high. Roughly eighteen publications appeared in print or were submitted for publication in the past twelve months, and six of the forty-eight of the scientific presentations at the 1999 Lake Arrowhead Tuna Conference were authored by PFRP affiliated scientists. The role of the PFRP in international scientific research Pacific appears to be growing. Eight presentations of PFRP-related research were made to the 1999 meeting of the Standing Committee on Tunas and Billfish, including a one-day workshop on model specifications of the bigeye stock assessment project. A considerable number of PFRP projects have made it into the peer-reviewed literature in 1999. A list of recent publications is attached.

Continuing Activities

Quarterly publication of the PFRP Newsletter continues to be a major activity, although the PFRP lost the Newsletter editor in 1999 and who will need to be replaced.

Production of an "International Module" for the WPRFMC Pelagics Annual Report has become an on-going activity. The module is a brief summary of the current status of the major tuna stocks in the Pacific Ocean culled from man sources. It contains maps of the annual distribution of catch of the major species by gear type at 5° longitude and latitude resolution. Coverage of the module will be expanded to include the entire Pacific Ocean from shore to shore, 40°S to 40°N.

Progress on Specific 1998-1999 Project Management Goals:

1. Conduct a new round of project solicitations

Several on-going projects will be concluding in the current funding cycle. Anticipated commitments for 1999 total about $1,300,000, so at normal levels of funding in FY1999, there should be approximately $500,000 available for new projects.

2. Coordinate an international Pacific-wide research project on bigeye tuna

A research coordination workshop was convened in Honolulu in November, 1998 to discuss plans for an international research effort on bigeye tuna. The original draft prospectus was revised and circulated to various private funding agencies. To date there have been no responses (negative or positive). The revised prospectus was tabled at twelfth meeting of the Standing Committee on Tunas and Billfish (SCTB) and was strongly endorsed by the Committee.

3. Improve funding procedures.

A thorough review of PFRP research priorities and procedures was conducted in July 1999. The review panel recommended several changes to PFRP operations that will improve the process of project selection and funding.

Project Management Goals for 1999-2000:

1. Conduct a new round of project solicitations.

Several on-going projects will be concluding in the current funding cycle. Anticipated commitments for FY2000 total about $1,300,000, so at normal levels of funding in FY2000, there should be approximately $500,000 available for new projects.

2. Implement recommendations of 1999 PFRP review panel.

The Panel made numerous recommendations for setting research priorities, reviewing proposals, and communication of results. Most of these recommendations can be relatively

easily implemented over the next 12 months. An implementation plan is in preparation.

3. Facilitate international collaboration in research on pelagic fisheries.

Publications

Block, Barbara A., Heidi Dewar, Charles Farwell, and Eric D. Prince, 1998: A new satellite technology for tracking the movements of Atlantic bluefin tuna. *Proceedings of the National Academy of Sciences*, 95:9384-9389, August 1998.

Brill, Richard W., Timothy E. Lowe, and Katherine L. Cousins, 1998b: How water temperature really limits the vertical movements of tunas and billfishes - It's the heart stupid. Abstract from the *American Fisheries Society, International Congress on Biology of Fish, July 26-20, 1998*, Towson University, Baltimore, Maryland.

Brill, R.W., B.A. Block, C.H. Boggs, K.A. Bigelow, E.V. Freund, and D.J. Marcinek, 1999: Horizontal and depth distribution of large adult yellowfin tuna (*Thunnus albacares*) near the Hawaiian Islands, recorded using ultrasonic telemetry: implications for the physiological ecology of pelagic fishes. *Marine Biology*, 133: 395-408.

Chakravorty, Ujjayant and John Sibert, 1999: Ocean-scale management of pelagic fisheries: Economic and regulatory issues. (Proceedings of an international workshop organized by the Pelagic Fisheries Research Program, JIMAR, UH, November 12-13, 1997). *SOEST Publication 99-01, JIMAR Contribution 99-321*, 102 pp.

Fonteneau, A., R. Allen, T. Pollachek, P. Pallares, J. Sibert and Z. Suzuki. 1999. Effect of tuna fisheries on the tuna resources and on the offshore pelagic ecosystems. *ICES/SCOR Symposium on Ecosystem Effects of Fishing*, Montpellier, France, 16-19 March 1999.

Fournier, D., J. Hampton, and J. Sibert, 1998. MULTIFAN-CL: a length-based, age-structured model for fisheries stock assessment, with application to south Pacific albacore, Thunnus alalunga. *Canadian Journal of Fisheries and Aquatic Sciences*, 55(9):2105 - 2116.

Grewe, Peter and John Hampton, 1998: An assessment of bigeye (*Thunnus obesus*) population structure in the Pacific Ocean, based on mitochondrial DNA and DNA microsatellite analysis. *SOEST Publication 98-05, JIMAR Contribution 98-320*, 23 pp.

Hamilton, Marcia, 1999: A system for classifying small boat fishermen in Hawaii. *Marine Resource Economics*, 13: 289-291.

Hamilton, Marcia, 1998: Cost-earnings study of Hawaii's charter fishing, 1996-1997. *SOEST Publication 98-08, JIMAR Contribution 98-322*, 105 pp.

Holland, K.N., P. Kleiber and S.M. Kajiura, 1999: Different residence times of yellowfin tuna, *Thunnus albacares*, and bigeye tuna, *Thunnus obesus*, found in mixed aggregations over a seamount. *Fishery Bulletin*, 97:392-395.

Klimley, A.P. and C.F. Holloway, 1999: School fidelity and homing synchronicity of yellowfin tuna, *Thunnus albacares*. *Marine Biology*, 133:307-317.

Leung, PingSun, Jill Muraoka, Stuart T. Nakamura, and Sam Pooley, 1998: Evaluating fisheries management options in Hawaii using analytic hierarchy process (AHP). *Fisheries Research*, 36 (1998): 171-183.

Lowe, T.E., R.W. Brill, and K.L. Cousins, 1998: Responses of the red blood cells from two high-energy-demand teleosts, yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Katsuwonus pelamis*) to catecholamines. *Journal of Comparative Physiology and Biology*, 168: 405-418.

Lutcavage, Molly E., Richard W. Brill, Gregory B. Skomal, Bradford C. Chase, and Paul W. Howey, 1999: Results of pop-up satellite tagging of spawning size class fish in the Gulf of Maine: do North Atlantic bluefin tuna spawn in the Mid-Atlantic? *Canadian Journal of Fisheries and Aquatic Sciences*, 56: 173-177 (1999).

Pan, Minling, PingSun Leung, Fang Ji, Stuart T. Nakamoto and Samuel G. Pooley, 1999: A multilevel and multiobjective programming model for the Hawaii fishery: Model documentation and application results. *SOEST Publication 99-04, JIMAR Contribution 99-324*, 84 pp.

(* with User's Manual by Omar El-Gayar and Fang Ji, 54 pp.)

Polovina, J.J., P. Kleiber and D.R. Kobayashi, 1999: Application of TOPEX/Poseidon satellite altimetry to simulate transport dynamics of spiny lobster, *Panulirus marginatus*, in the Northwestern Hawaiian Islands, 1936-1996. *Fishery Bulletin*, 97:132-143.

Sharma, K.R. and P.S. Leung, 1998: Technical efficiency of the longline fishery in Hawaii: An application of stochastic production frontier. *Marine Resource Economics*, 13(4): 259-274.

Sibert, J. R., J. Hampton, D. A. Fournier, and P. J. Bills. 1999. An advection-diffusion-reaction model for the estimation of fish movement parameters from tagging data, with application to skipjack tuna (Katsuwonus pelamis). *Can. J. Fish. Aquat. Sci.* 56: 925-938

Stocker, Sabine, 1999: Models for tuna school formation. *Mathematical Biosciences*, 156(1999): 167-190.

OTHER PAPERS, TECHNICAL REPORTS, MANUSCRIPTS

Boggs, C., M. Musyl, and R. Brill, 1998: Results from archival tagged bigeye tuna. *Hawaii Fishing News*, September 24, 1998.

Brill, R.W. and P.G. Bushnell, 1998: Cardiovascular systems of tunas. Manuscript in preparation for a chapter in *Fish Physiology*, vol. 14, Academic Press.

Brill, R., M. Lutcavage, G. Metzger, P. Bushnell, M. Arndt, J. Lucy, and C. Watson, 1998: Horizontal and vertical movements of juvenile Atlantic bluefin tuna (*Thunnus thynnus*) determined using ultrasonic telemetry, with reference to population assessment using aerial surveys. *Fishery Bulletin*, in preparation.

Chakravorty, Ujjayant, Keiichi Nemoto and KinPing Tse, 1998: A spatial-dynamic model for the allocation of fishing effort with application to the Hawaii longline fishery. *Journal of Environmental Economics and Management*, in review.

Curtis, Rita E., 1999: A random utility model of dynamic supply response under uncertainty: The case of the Hawaii longline fishery. PhD dissertation (Economics), University of Maryland.

Firing, E., B. Qiu and W. Miao, 1999: Time-dependent island rule and its application to the time-varying North Hawaiian Ridge Current. *Journal of Physical Oceanography*, in press.

Hampton, John, and David Fournier, 1998: Preliminary analysis of yellowfin tuna catch, effort, size and tagging data using an integrated age-structured model.

Jones, D.R., R.W. Brill, K.L. Cousins, P.B. Bushnell, J.F. Steffensen and J.K. Keen, 1998: Capilary permeability and starling forces in three teleosts: yellowfin tuna (*Thunnus albacares*), rainbow trout (*Onchorynchus mykiss*), and cod (*Gadus morhua*). *American Journal of Physiology*, in preparation.

Lowe, T., R. Brill and K. Cousins, 1998: Unusually high blood oxygen affinity from a high-energy-demand teleost, bigeye tuna *Thunnus obesus*. *Marine Biology*, submitted.

Lumpkin, Claude Frederick, 1998: Eddies and currents of the Hawaiian Islands. Ph.D dissertation (Oceanography), University of Hawaii at Manoa.

Lutcavage, M.E., R.W. Brill, J.L. Goldstein, G.B. Skomal, B.C. Chase and j. Tutein,

1998: Movements and behavior of adult northern bluefin tuna (*Thunnus thynnus*) in the northwest Atlantic determined using ultrasonic telemetry. *Marine Biology*, in preparation.

McConnell, Kenneth E., 1999: Hedonic prices for fish: Tuna prices in Hawaii. *American Journal of Agricultural Economics*, forthcoming.

Neubauer, Deane and Kerry Burch, 1998: Alternative perspectives on fishery management decision-making, under review.

Polovina, J.J., D.R. Kobayashi, D.M. Ellis, M.P. Seki and G.H. Balazs, 1998: Life on the edge: Movement of loggerhead turtles (*Caretta caretta*) along oceanic fronts in the central North Pacific, 1997-1998. *Fisheries Oceanography*, in review.

Reeb, C.A., L. Arcangeli and B.A. Block, 1999: Population structure and migration corridors in the Pacific swordfish, *Xiphias gladius*, as inferred through analysis of mitochondrial DNA. *Marine Biology*, submitted.

Reeb, C.A., L. Arcangeli and B.A. Block, 1999: The genetic structure of swordfish (*Xiphias gladius*) populations as inferred through the analysis of eleven microsatellite loci. *Molecular Ecology*, in preparation.

Seki, M.P., J.J. Polovina, D.R. Kobayashi and G.T. Mitchum, 1998: An oceanographic characterization of swordfish longline fishing grounds in the Subtropical Central North Pacific. In preparation.

Swimmer, Y.B. and R.W. Brill, 1998: Intestinal NA+-K+ ATPase and Na+-H+ ATPase activity, and osmoregulatory costs in a high-energy-demand teleost, the yellowfin tuna (*Thunnus albacares*). *Marine Biology*, in preparation.

Travis, Michael D., 1998: Chronology of regulatory events relevant to Hawaii's pelagic longline fishery, 1987-96, under review.

CONFERENCE PRESENTATIONS

Block, Barbara, 1999: Likely corridors of migration revealed in a highly migratory fish. Paper presented at the 1999 Evolution Meetings, Madison, Wisconsin.

Chakravorty, Ujjayant, Keiichi Nemoto, Kinping Tse and John Yanagida, 1999: A spatial-dynamic model for the allocation of fishing effort: Application to the Hawaii longline pelagic fishery. In Chakravorty, Ujjayant and John Sibert, 1999: Ocean-scale management of pelagic fisheries: Economic and regulatory issues. (Proceedings of an international workshop organized by the Pelagic Fisheries Research Program, JIMAR,

UH, November 12-13, 1997). *SOEST Publication 99-01, JIMAR Contribution 99-321.*

Chakravorty, Ujjayant and Keiichi Nemoto, 1999: A spatial-dynamic model for the allocation of fishing effort with application to the Hawaii longline fishery. Proceedings of the 50th Annual Tuna Conference, Lake Arrowhead, California, May 1999.

Itano, D. and K.N. Holland, 1999: Hawaii tuna tagging project - where we are. Proceedings of the 50th Annual Tuna Conference, Lake Arrowhead, California, May 1999.

Holland, K.N, 1999: Attaching the tag to the task: The convictions of a stalker. Proceedings of the 50th Annual Tuna Conference, Lake Arrowhead, California, May 1999.

Holland, K.N. and S.M. Kajiura, 1999: Movements of tunas around a mid-ocean archipelago. Paper presented at XVIII International Week of Fisheries, Horta, Azores, March 1999.

Leung, PingSun, Minling Pan, Fang Ji, Stuart T. Nakamoto, and Sam G. Pooley, 1999: A bilevel and bicriterion programming model of Hawaii's multifishery. In: Chakravorty, Ujjayant and John Sibert, 1999: Ocean-scale management of pelagic fisheries: Economic and regulatory issues. (Proceedings of an international workshop organized by the Pelagic Fisheries Research Program, JIMAR, UH, November 12-13, 1997). *SOEST Publication 99-01, JIMAR Contribution 99-321.*

Polovina, J.J., 1999: Habitat of loggerhead turtles and an evaluation of space and area closures in the Hawaii longline fishery to reduce incidental captures of loggerhead turtles. Proceedings of the 50th Annual Tuna Conference, Lake Arrowhead, California, May 1999.

Porter, Richard, 1999: A study of the U.S. Atlantic pelagic longline fishery: A fleet in transition. Paper presented at the Conference on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the UN Agreement, Centre for Fisheries Economics, Norwegian School of Economics and Business Administration, Bergen, Norway, May 19-21, 1999.

Travis, Michael D., 1999: Entry and exit in Hawaii's longline fishery, 1988-1996: A preliminary view of explanatory factors. In Chakravorty, Ujjayant and John Sibert, 1999: Ocean-scale management of pelagic fisheries: Economic and regulatory issues. (Proceedings of an international workshop organized by the Pelagic Fisheries Research Program, JIMAR, UH, November 12-13, 1997). *SOEST Publication 99-01, JIMAR Contribution 99-321.*

Appendix 9

Value of pelagic fisheries

Domestic Pelagic Fisheries

The management of pelagic fisheries is of particular importance to the Western Pacific Council, as the harvest of highly migratory species is the major fishing industry in the region. The central and western Pacific contain immense pelagic fishery resources and provide more than 40 per cent of the world tuna catch. The annual landings of various tuna species harvested from the region total over one million metric tons (mt), with a dockside value of $1.5 billion [1].

When the Western Pacific Council was created in 1977 foreign fleets were fishing heavily for tuna as close as twelve miles to American-flag Pacific islands. The Council's initial priority was to restrict foreign fishing and allow domestic fishermen more opportunities to catch fish. Hawaii, being the most industrialized and populated island area, was in the best position to support an expansion of the domestic commercial fishery. The number of Hawaii-based longliners skyrocketed in the late 1980's. Landings by longline vessels increased from 1,900 mt to 11,500 mt between 1987 and 1993. The inflation-adjusted ex-vessel value of the catch more than tripled during this period to $56 million. Swordfish catches accounted for most of this revenue and represented about 60% of the total US domestic landings for this species. More recently, the longline fleet has increasingly targeted tuna species, and the harvest of albacore, bigeye and yellowfin reached a record high of 7,651 mt in 1997. The value of the commercial landings of all pelagic species during that year was $60.9 million. In 1998, the amount of tuna landed declined to 6,850 mt, and the value of the commercial landings of all pelagic species fell to $54.8 million.

The expansion of the longline fishery in Hawaii during the past decade has been accompanied by a general trend away from "bulk fisheries" for pelagic species (e.g., fish cake and canned tuna) and development of "quality," high-price products (e.g., *sashimi* tuna) that have enhanced the market value of Hawaii's pelagic fisheries [2]. Local and export markets for Hawaii's seafood products have expanded enormously in recent years, and fresh fish from Hawaii's waters now appears on restaurant menus throughout the United States, from Honolulu to Des Moines to Boston [3]. In 1998, the port of Honolulu ranked 30th in the nation in terms of the quantity of fish landed, but it ranked 7th in terms of the value of fish landings (Table 1, following page).

Hawaii's smaller-scale troll and handline fishery has also benefitted in recent years from expanding local and export markets for high quality seafood products. Annual revenues within this fishery average around $9 million. Related to the troll fishery is the charter boat industry that

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1 Lawson, T. [ed.] 1995. SPC Tuna Fishery Yearbook, 1994. South Pacific Commission, Noumea, New Caledonia, 77 pp.

2 Boehlert, G. W., 1993. Fisheries and marine resources of Hawaii and the U.S.-associated Pacific Islands: An introduction. Mar. Fish. Rev. 55(2):3-6.

3 Pooley, S.G., 1993. Hawaii's marine fisheries: Some history, long-term trends, and recent developments. Mar. Fish. Rev. 55(2):7-19.

targets billfish, tuna and other pelagic species mainly for a tourism-based clientele. It is estimated that charter boat patrons in Hawaii spend $61 million (adjusted to 1995 dollars) a year on charter fishing as a vacation or leisure activity [4]. Another indication of the economic importance of the charter boat industry is that the winner of a 1998 fishing tournament in Kona won $111,000 after landing a 500 lb blue marlin.

Table 1. Ex-vessel value of commercial fishery landings by domestic and foreign vessels at major US ports.

Port	Value of Landings -Million Dollars-		
	1996	1997	1998
Pago Pago, American Samoa	211.8	192.7	~232.0
Dutch Harbor-Unalaska, Alaska	118.7	122.6	110.0
New Bedford, Massachusetts	100.5	103.2	93.5
Agana, Guam	94.2	NA	NA
Kodiak, Alaska	82.3	88.6	78.7
Brownsville-Port Isabel, Texas	60.0	46.1	64.2
Honolulu, Hawaii	50.1	53.7	49.0
Key West, Florida	62.8	54.9	44.8
Reedville, Virginia	NA	29.5	42.6
Point Judith, Rhode Island	46.0	47.6	41.8

Sources: National Marine Fisheries Service and Western Pacific Fishery Management Council.

Distant-Water Pelagic Fisheries

Other island areas in the Council's jurisdiction have not experienced the same increase in domestic industrial scale fisheries that recently occurred in Hawaii. Although the size of the local fishing fleets of American Samoa, Guam and the CNMI have expanded in recent years, the fleets continue to consist of small boats operated by mostly part-time fishermen. However, these islands have discovered alternative ways to take economic advantage of expanding Pacific pelagic fisheries. Tuna processing, transshipment and home-porting industries have developed in these islands because they possess a comparative economic advantage over other locations in the

[4] Samples, K. And D. Schug, 1985. Charter fishing patrons in Hawaii: a study of their demographics, motivations, expenditures and fishing values. US Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-85-8C, 95 pp.

region. These advantages include proximity to fishing grounds, shipping routes and markets; the availability and relatively low cost of fuel and other goods and services that support tuna fishing operations; tariff-free market access to the US; and significant tax incentives.

For many years American Samoa's capital of Pago Pago has been the site of a major tuna canning industry and one of the leading ports in the United States in terms of the dollar value of fish landings (Table 1). At present, the Star-Kist cannery at Pago Pago is the world's largest tuna processing facility. In 1998, American Samoa received 208,300 short tons of fish worth approximately $232 million. Since the tuna processing industry began in American Samoa four decades ago, it has been the largest private sector employer in the Territory and leading exporter. The principal suppliers of tuna to the canneries are island-based US purse seiners that fish primarily in the central and western Pacific for skipjack and yellowfin tuna. During some years, particularly during an *El Niño*-Southern Oscillation event, a substantial portion of the US purse seine harvest comes from the EEZ around Palmyra Atoll, Jarvis Island, Howland Island and Baker Island. For example, 36,970 mt of skipjack and yellowfin tuna were caught around these islands in 1997. Other major suppliers of tuna to the canneries in American Samoa include US albacore trollers operating in the north and south Pacific and foreign longline vessels that fish for large albacore, yellowfin and bigeye tuna. In addition, freezer vessels deliver tuna to American Samoa from various transshipment centers around the Pacific. During the past decade Guam has been one of the largest tuna transshipment centers in the Pacific. The value of the fish transshipped in Guam in 1996 was estimated to be more than $94 million. Frozen fish is delivered by US and foreign purse seiners and fresh fish is landed by foreign longliners or air-freighted from the Marshall Islands, Federated States of Micronesia and other neighboring Pacific islands.

A particularly lucrative activity related to the tuna canning and transshipment industry is the re-supplying of fishing boats which deliver the fish. Pago Pago and Apra harbor in Guam are home ports to several hundred longline and purse seine vessels. Expenditures by these fleets on fuel, provisions and repairs make an important contribution to the economies of these islands. Annual local fleet expenditures in American Samoa were estimated in 1994 to be as high as $122 million[5]. Fleet expenditures in Guam were about $68 million in 1998 (Guam Department of Commerce, 1999). This home-porting industry in the islands has both created primary jobs and enhanced investment opportunities for local entrepreneurs.

Subsistence and Recreational Fisheries

While it is important to recognize and document the significant role marine fisheries play in contemporary Pacific island economies, it is equally important to keep in mind that the value of these fisheries extends beyond the creation of employment and the generation of exports and income. Fishing activities have been interwoven into the daily lives of the people of the Pacific islands for hundreds if not thousands of years. Over time, local communities developed a close,

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5 Hamnett, M. And W. S. Pintz, 1996. The contribution of tuna fishing and transshipment to the economies of American Samoa, the Commonwealth of the Northern Mariana Islands and Guam. JIMAR Contribution (6-303), Joint Institute for Marine and Atmospheric Research, Honolulu, 38 pp.

emotional as well as utilitarian association with the marine environment. It shaped their social organization and cultural values.

Most island residents today no longer depend on their catches for food, but seafood continues to be an integral part of the local diet. In Hawaii, for example, the per capita consumption of seafood is almost twice the national US average and is comparable to that of other Pacific islands. There has been no attempt to formally assess the subsistence fishing contribution to island economies, but the value to consumers is known to be substantial. In particular, subsistence fishing is an important supplement to cash income in many rural communities despite increasing commercialization of the catch in these areas.

Fishing also continues to contribute to the cultural integrity and social cohesion of Pacific island communities. In American Samoa, for instance, skipjack tuna, known locally as *atu*, is an especially important species both nutritionally and culturally. The methods and equipment for catching skipjack have changed, but the fish brought to shore continue to be distributed within Samoan villages according to age-old ceremonial traditions. One can find similar traditions still practiced in Hawaii, the Northern Mariana Islands and Guam. These sociocultural attributes of fishing are at least as important as the contributions made to the nutritional or economic well-being of island residents.

The fish resources under Council jurisdiction also support an important private boat recreational fishery that targets both pelagic and bottom-dwelling species. Maharaj and Carpenter[6] estimated that 1996, a total of 260,000 US anglers participated in a total of 2.5 million recreational fishing trips in Hawaii. The researchers estimated that the total fishing trip-related expenditures that year was $130 million, of which $96 million was trip-related expenses ($37 million for food and lodging, $33 million for transportation and $27 million for bait, fuel and equipment rental), $33 million was for fishing-related equipment and $949,000 was for miscellaneous items. However, sports fishermen value the activity of fishing over and above what they spend to engage in it. A study conducted some years ago that asked fishermen what their sport fishing experience was actually worth to them in dollar terms estimated the value of fishing trips to Hawaii recreational fishermen to be $347 million (adjusted to 1995 dollars)[7].

One component of recreational fishing that has gained in popularity is tournament fishing. Most notable is the Hawaiian International Billfish Tournament conducted annually on the "Big Island" of Hawaii. Since its inception in 1958, this tournament has consistently attracted the most serious big game anglers in the world. In 1995, 72 boats with fishermen from 15 countries participated. Tournament fishing for pelagic species is also becoming increasingly important in American Samoa and Guam and accounts for a significant portion of domestic landings.

Dynamic Aspects of Fisheries

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6 Maharaj, V. and J. Carpenter, 1998. The 1996 economic impact of sport fishing in Hawaii. American Sportfishing Association/US Fish and Wildlife Service.

7 Meyer Resources, Inc., 1987. A report on resident fishing in the Hawaiian Islands. US Dep. Commer., NOAA, Natl. Mar. Fish. Service, Southwest Fish Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-87-8C, 74 pp.

The fisheries of the western and central Pacific are in constant flux. This is especially true of the fisheries for tuna, billfish and other pelagic species. Fishing fleets that face restrictions or declining stocks in other areas of the world are appearing in the Pacific islands region in ever-increasing numbers. Fish prices, fishing costs and international exchange rates are subject to large random variations and cyclical movements. The fish resources themselves are very mobile and their abundance fluctuates between seasons and from year to year.

Pacific pelagic stocks are the targets of increasingly intense competition among the many US and foreign vessels operating on the high-seas and within the EEZs of Pacific islands. Furthermore, both US-affiliated and foreign Pacific islands are vying with one another to maximize their share of the short and long-term economic benefits generated by these fisheries. To date, the pay-off for the Pacific islands as a whole has been limited largely to the collection of access fees. Island nations which are regional neighbors to Guam and the Northern Mariana Islands derive substantial income from the sale of permits allowing foreign fishing vessels access to their EEZs. The 1996 Magnuson-Stevens Act provides Guam, the Northern Mariana Islands and American Samoa with the opportunity to profit from fishing agreements with distant water fishing nations.

Access fees, however, represent only a small fraction of the value of the tuna fish harvested by foreign vessels. Currently, average access fees are a little more than 4 percent of the value of the catch (that is, the reported catch - illegal fishing by some countries may be high). To capture additional benefits many of the islands are endeavoring to develop further their own commercial fishing capabilities as well as improve their port, fish processing and transshipment facilities associated with offshore fishing operations. The difficulty is that investment in fisheries development is a highly capital-intensive undertaking - be it in vessels, canneries or transshipment bases - and given the high risk and technical requirements of the sector, success is not easy to achieve [8]. Government investment in development of industrial fishing operations has a dismal track record; there has yet to be a single financially viable government fishing enterprise in the tropical central and western Pacific. However, governments can play a crucial role in enhancing private sector investment in fisheries development by helping identify economic opportunities and facilitating business access via infrastructure improvements, financing, training, regulatory relief and product promotion [9].

Possible obstacles that may inhibit the US-affiliated Pacific islands from realizing continuing high growth in the fisheries sector include competing Asian domestic production, highly restrictive quality and handling requirements for *sashimi*-grade product, limited port infrastructure to accommodate expanded fishing fleets and high labor costs [10]. The dynamic nature of fisheries in the region makes it difficult to predict the degree to which the islands will be able to surmount these obstacles. However, what is certain is the importance of providing for

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8 World Bank, 1995. Pacific Island Economies: Building a Resilient Economic Base for the Twenty-First Century. World Bank Report No. 13803-EAP, 139 pp.

9 MacDonald. C., Deese, H., Corbin E. and A. Clark, 1995. New projections for Hawaii's ocean industries: a strategic orientation. In OCEANS '95 Proceedings, October 9-12, IEEE and Marine Technology Society, Washington, D.C.

10 MacDonald. C., Deese, H., Corbin E. and A. Clark, 1995. New projections for Hawaii's ocean industries: a strategic orientation. In OCEANS '95 Proceedings, October 9-12, IEEE and Marine Technology Society, Washington, D.C.

the conservation and future sustainable use of the region's fishery resources. Regardless of what particular economic scenario transpires in the islands of the Western Pacific, these resources are likely to remain one of the islands' most valuable cultural, recreational and commercial assets.

Appendix 10

GLOSSARY — PELAGICS

TERM	DEFINITION
Alia	Samoan fishing catamaran, about 30 feet long, constructed of aluminum or wood with fiberglass. Used for various fisheries including trolling, longline, and bottomfishing
AP	Advisory Panel. Appointed industry/government/educational representatives functioning in an advisory capacity to the Council.
AS	American Samoa. Includes the islands of Tutuila, Manua, Rose and Swains Atolls.
ASDPW	Department of Public Works, American Samoa. Also, DPW.
Bycatch	Fish caught in a fishery but discarded or released, except in a recreational fisheries catch and release program.
Commercial	Commercial fishing, where the catch is intended to be sold, bartered, or traded.
CNMI	Commonwealth of the Northern Mariana Islands. Also, Northern Mariana Islands, Northern Marianas, and NMI. Includes the islands of Saipan, Tinian, Rota, and many others in the Marianas Archipelago.
CPUE	Catch-Per-Unit-Effort. A standard fisheries index usually expressed as numbers of fish caught per unit of gear per unit of time, eg., number of fish per hook per line-hour or number of fish per 1,000 hooks. The term catch rate is sometimes used when data are insufficiently detailed to calculate an accurate CPUE.
DAWR	Division of Aquatic & Wildlife Resources, Territory of Guam.
DBEDT	Department of Business, Economic Development & Tourism, State of Hawaii.
DFW	Division of Fish & Wildlife, Northern Mariana Islands.
DLNR	Department of Land & Natural Resources, State of Hawaii. Parent agency for Division of Aquatic Resources (HDAR).
DMWR	Department of Marine & Wildlife Resources, American Samoa. Also, MWR.
EEZ	Exclusive Economic Zone, refers to the sovereign waters of a nation, recognized internationally under the United Nations Convention on the Law of the Sea as extending out 200 nautical miles from shore. Within the U.S., the EEZ typically is between three and 200 nautical miles from shore.
ESA	Endangered Species Act. An Act of Congress passed in 1966 that establishes a federal program to protect species of animals whose survival is threatened by habitat destruction, overutilization, disease etc.
FAD	Fish Aggregating Device; a raft or pontoon, usually tethered, and under which, pelagic fish will concentrate.
FDCC	Fishery Data Coordinating Committee, WPRFMC.
FFA	Forum Fisheries Agency. An agency of the South Pacific Forum, which comprises the independent island states of the South Pacific, Australia and New Zealand. The FFA formed to negotiated access agreements between FFA member countries and distant water fishing nations such as Japan and the USA.

FMP	Fishery Management Plan.
Guam	A U.S. territory in the Marianas Archipelago. South of and adjacent to the Commonwealth of Northern Marianas Islands.
Hawaii	U.S. state. See MHI, NWHI. Composed of the islands, atolls and reefs of the Hawaiian Archipelago from Hawai'i to Kure Atoll, except Midway Islands. Capitol - Honolulu.
HDAR	Hawaii Division of Aquatic Resources. Also, DAR.
HIMB	Hawaii Institute of Marine Biology, University of Hawaii.
HURL	Hawaii Undersea Research Lab.
JIMAR	Joint Institute of Marine and Atmospheric Research, University of Hawaii.
IATTC	Inter-American Tropical Tuna Commission.
Ika-shibi	Hawaiian term for nigh tuna handline fishing method. Fishing for tuna using baited handlines at night with a nightlight and chumming to attract squid and tuna.
Incidental Catch	Fish caught that are retained in whole or part, though not necessarily the targeted species. Examples include monchong, opah and sharks.
Interaction	Catch of protected species, which is required to be released. Examples: Hawaiian monk seals, marine turtles and albatrosses.
Logbook	Journal kept by fishing vessels for each fishing trip; records catch data, including bycatch and incidental catch. Required in the federally regulated longline and crustacean fisheries in the Hawaiian EEZ.
Longline	Fishing method utilizing a horizontal mainline stretching from several hundred yards to many miles in length, suspended for the surface by floats, to which droppers with baited hooks are attached.
Longliner	Fishing vessel specifically adapted to use the longline fishing method.
MFCMA	Magnuson Fishery Conservation and Management Act of 1976. Also, Magnuson-Stevens Fishery Conservation and Management Act of 1996. Sustainable Fisheries Act.
MHI	Main Hawaiian Islands (comprising the islands of Hawai'i, Mau'i, Lana'i, Moloka'i, Kaho'olawe, O'ahu, Kauai', Ni'ihau and Ka'ula).
MSY	Maximum Sustainable Yield.
NMFS	National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. Also NOAA Fisheries.
NOAA	National Oceanic and Atmospheric Administration, Department of Commerce.
NWHI	Northwestern Hawaiian Islands. All islands in the Hawaiian Archipelago, other than the Main Hawaiian Islands (MHI).
OFP	Oceanic Fisheries Program of the South Pacific Commission.
OY	Optimum Yield.
Palu-ahi	Hawaiian term for day tuna handline fishing. Fishing for tuna using baited handlines and chumming with cut bait in a chum bag or wrapped around a stone. Also, drop-stone, make-dog, etc.
PAO	Pacific Area Office, National Marine Fisheries Service. Also, NMFS/PAO.

Pelagic	The pelagic habitat is the upper layer of the water column from the surface to the thermocline. The pelagic species include all commercially targeted highly migratory species such as tuns, billfish and some incidental-catch species such as sharks, as well as coastal pelagic species such as akule and opelu.
PFRP	Pacific Pelagic Fisheries Research Program, JIMAR, University of Hawaii. Also PPFRP.
PMUS	Pacific Pelagic Management Unit Species. Also, PPMUS. Species managed under the Pelagics FMP.
Pole-and-Line	Fishing for tuna using poles and fixed leaders with barbless lures and chumming with live baitfish. Poles can be operated manually or mechanically. Also, fishing vessels called baitboats or aku-boats (Hawaii).
Protected	Refers to species which are protected by federal legislation such as the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act. Examples: Black-footed and Laysan albatrosses, marine turtles, dolphins.
PT or PPT	Pelagic Plan Team. Advisory body to the Council composed of scientists and fishermen who monitor and manage the fisheries under the jurisdiction of the Pelagics FMP.
Purse seine	Fishing for tuna by surrounding schools of fish with a very large net and trapping them by closing the bottom of the net.
Recreational	Recreational fishing for sport or pleasure, where the catch is not sold, bartered or traded.
SAFE	Stock Assessment and Fishery Evaluation, NMFS.
Sanctuary	Protected area. Commercial/recreational fishing may be restricted.
Secretary	When capitalized and used in reference to fisheries within the U.S. EEZs, it refers to the U. S. Secretary of Commerce.
Small pelagics	Species such as akule (big-eye scad - *Selar* spp.) And opelu (mackerel scad - *Decapterus* spp). These fish occur mainly in shallow inshore waters but may also be found in deeper offshore waters. Not part of the PMUS.
SPC	South Pacific Commission. A technical assistance organization comprising the independent island states of the tropical Pacific Ocean, dependant territories and the metropolitan countries of Australia, New Zealand, USA, France and Britain.
SPR	Spawning Potential Ratio. A term for a method to measure the effects of fishing pressure on a stock by expressing the spawning potential of the fished biomass as a percentage of the unfished virgin spawning biomass. Stocks are deemed to be overfished when the SPR<20%.
SSC	Scientific & Statistical Committee, an advisory body to the Council comprising experts in fisheries, marine biology, oceanography, etc.
Trolling	Fishing by towing lines with lures or live-bait from a moving vessel.
USCG	U.S. Coast Guard, 14th District, Department of Transportation.
USFWS	U.S. Fish & Wildlife Service, Department of Interior. Also, FWS.
VMS	Vessel Monitoring System. A satellite based system for locating and tracking fishing vessels. Fishing vessels carry a transponder which can be located by overhead satellites. Two-way communication is also possible via most VMS systems.
WPacFIN	Western Pacific Fishery Information Network, NMFS.
WPRFMC	Also, the Council. Western Pacific Regional Fishery Management Council. One of eight nationwide fishery management bodies created by the Magnuson Fisheries Conservation and